elektor supplement

semi-conductors

where
do we go
from here ?

The Proto-Board®

Now circuit designing is as easy as pushing a lead into a hole.

No soldering.
No de-soldering.
No heat-spoilt components.
No manual labour.
No wasted time.

POWER ON
Proto-Board no. 203A
+5Vat 1.0 AMP
+15Vat 0.5 AMP
−15Vat 0.5 AMP
Continental Specialties Corporation, 44 Kendall St., New Haven, Connecticut 06511

With a Proto-Board you can hook your circuit together as quickly as you can think.

And you can have second thoughts, and third thoughts, equally quick and easy, till you've got the whole thing right.

Then you can solder up if you want to, but most engineers don't because the Proto-Board push-fit connectors are highly reliable.

And everything is visible; come back next week and you 'read' the circuit immediately.

Contact terminals are arranged in sets of five, each connected across the back, and in the Model 203A illustrated you get 1770 contacts, in six rows of 59 × 5, plus four double power rails, each with 100 contacts connected lengthwise and two horizontal power units with 40 contacts each. Many other models; see chart.

Proto-Board breadboards will accept transistors, ICs, LSI packages, resistors, capacitors, LEDs, trimmers, relays etc.; most plug straight in.

Try one. You'll wonder how you ever managed without it.

Model Number	No. of Solderless Tie-points	IC Capacity (14-pin DIP's)	Unit Price	Postage & Package	VAT	Total Price	Other features
PB-6	630	6	£ 9.20	£1.00	£0.82	£11.01	Kit–10 minute assembly
PB-100	760	10	11.80	1.00	1.02	13.82	Kit–with larger capacity
PB-101	940	10	17.20	1.25	1.48	19.93	8 distribution buses, higher capacity
PB-102	1240	12	22.95	1.25	1.94	26.14	Large capacity, moderate price
PB-103	2250	24	34.45	1.50	2.88	38.83	Even larger capacity; only 1.73 pence per tie-point
PB-104	3060	32	45.95	1.50	3.80	51.25	Largest capacity; lowest price per tie-point
PB-203	2250	24	55.15	1.50	4.53	61.18	Built-in 1%-regulated 5V, 1 A low ripple power supply
PB-203A	2250	24	74.10	1.50	6.10	82.30	As above plus separate ½ Amp +15V and −15V internally adjustable regulated supplies

How to order. Telephone 01-890 0782 and give us your Access, Barclaycard or American Express number, and your order will be in the post that night. Or, write your order, enclosing cheque, postal order, or stating credit card number and expiry date. (Don't post the card!). Alternatively, ask for our latest catalogue, showing all CSC products for the engineer and the home hobbyist. *(Prices are for UK only. For Europe add 10%, outside Europe add 12½% to total prices.)*

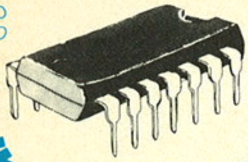
CONTINENTAL SPECIALTIES CORPORATION

CONTINENTAL SPECIALTIES CORPORATION (UK) LTD
SPUR ROAD NORTH FELTHAM TRADING ESTATE FELTHAM
MIDDLESEX TW1 4OTJ P TELEPHONE: 01-890 0782 TELEX: 881 3669.

REGISTERED IN LONDON 303780 VAT No. 224470 7471
TRADE MARK APPLIED FOR 'CSC (UK) LTD 1977
DEALER ENQUIRIES WELCOME

How to order. For delivery by return please send cheque with order. Personal customers can use Access, Barclaycard or American Express Card; order by post or phone, or send for complete CSC catalogue.

elektor supplement



ABC

U.K. editorial offices, administration
and advertising: Elektor Publishers Ltd.,
Elektor House, 10 Longport Street,
Canterbury CT1 1PE, Kent. U.K.
Tel.: Canterbury (0227)54430.
Telex: 965504.

Assistant Manager R.G. Knapp
Advertising Niall M. Willis
Editorial T. Emmens

semiconductors where do we go from here?

Happy birthday transistor

Within the lifetime of many Elektor readers a revolution has occurred whose consequences are so far reaching that they cannot accurately be predicted. In the space of 30 years the semiconductor industry has grown from nothing to the multi-million pound giant that it is today.

The following – of necessity somewhat generalised – article traces the major developments in the evolution of semiconductors, showing how they have affected the life of the average person. The discussion is rounded off with a look at what the future holds – in what areas semiconductors will continue to exercise a shaping force in modern life.

Although the junction transistor was invented during the last days of 1947, and indeed the field-effect transistor had been postulated some years earlier, it was 1948 that marked the birth of the semiconductor industry, for in that year the first practical transistor was produced by Bell Telephone Laboratories. This was a point-contact device developed by Bardeen and Brattain, who discovered it almost by accident whilst investigating the properties of point contact diodes in an attempt to develop a fuller understanding of the physics involved. While probing a germanium *base* material with wire contacts, one *emitting* current into the base material and the other *collecting* current from it, they discovered that current amplification was occurring.

It is amusing to note how the terms associated with transistors, and indeed the circuit symbol for a transistor, sprang from those early experiments.

It soon became apparent that the point contact transistor was difficult to produce in large quantities, and also had severe performance limitations, particularly in regard to power handling. The junction transistor, which had been developed by Bardeen and Brattain's co-worker Shockley, was a much more practical device, and 1950 saw the introduction of the first commercial junction transistor. These early devices were of the alloy junction type, typically fabricated by alloying pellets of indium to either side of a thin silver of germanium, as shown in figure 1.

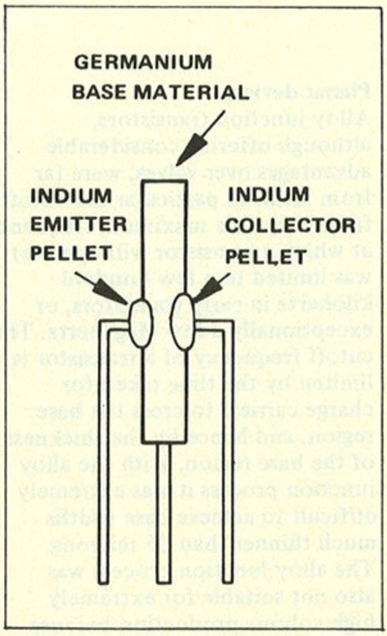


Figure 1. Cross-section of an alloy-junction transistor.

The late 1940s and early 1950s saw the rapid growth of electronics for military and aerospace applications, where small size, low power consumption and reliability were of paramount importance. The 1940s also witnessed the birth of the electronic digital computer. Although calculating machines using relay logic had been developed prior to and during World War II, primarily for cryptanalysis, these were slow and frequently unreliable. The first completely electronic computer, using valves, was developed by mathematicians from Cambridge University in order to decipher the German 'enigma' codes. This was followed in 1945 by ENIAC, a massive computer employing some 18,000 valves and occupying 3000 cubic feet, which was developed at the University of Pennsylvania. The use of valves instead of electromechanical elements greatly increased the speed at which data manipulation and mathematical operations could be performed. However, ENIAC more or less represented the limit of valve computers because of reliability problems, to say nothing of size and power consumption. The relatively high failure rate of valves meant that a computer with several thousand valves would spend a significant part of its life having valves replaced, whilst a computer with tens of thousands of valves would be almost impossible to maintain in working order.

With transistors, on the other hand, once early 'infant mortality' failures have been eliminated the life of a device is almost indefinite, and of course even early transistors offered a considerable size advantage over valves, as shown in figure 2.

Military and aerospace requirements gave a large initial impetus to the semiconductor industry and as the potential of computers were realised, so the developing computer industry became a large user of semiconductors.

The initial impact of semiconductors on the average person was less dramatic, since domestic electronic equipment of the 1950s was generally limited to simple, *linear* circuits such as radios, TV sets and record players, employing relatively small numbers of valves, which at that time were cheaper than transistors. It was not until the late 1950s and early 1960s, when transistors became cheaper due to their extensive use for military and computer applications, that the craze for compact transistor radios marked the first inroads of semiconductors into the consumer market.

The early transistors were almost exclusively germanium devices. However, as the semiconductor industry grew the properties of other semiconductor materials were investigated, and silicon ultimately displaced germanium as the most widely used material. Silicon offers a number of advantages; to begin with, it is an extremely common element, the world's beaches contain vast amounts of silicon in the form of sand (silica). Silicon transistors exhibit lower leakage currents than germanium types and can operate at higher temperatures.

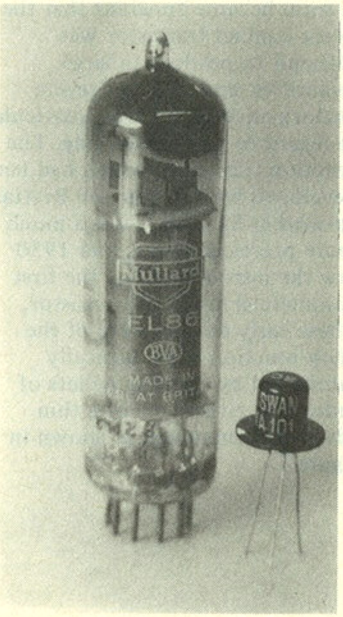


Figure 2. Even early transistors offered great advantages over valves in terms of size, power consumption and reliability.

Planar devices

Alloy junction transistors, although offering considerable advantages over valves, were far from ideal. In particular the cutoff frequency (the maximum frequency at which a transistor will operate) was limited to a few hundred kilohertz in early transistors, or exceptionally a few Megahertz. The cutoff frequency of a transistor is limited by the time taken for charge carriers to cross the base region, and hence by the thickness of the base region. With the alloy junction process it was extremely difficult to achieve base widths much thinner than 25 microns. The alloy junction process was also not suitable for extremely high volume production because of the fact that each transistor had to be processed from an individual sliver of base material.

The problems of more closely controlled manufacture and high-volume production were solved with the introduction of the planar process, whihc was developed by Jean Hoerni of the Fairchild company in 1958. This allowed many transistors to be fabricated simultaneously on a large wafer of semiconductor material. An outline of the planar processing technique is shown in figure 3.

The starting material for a batch of NPN transistors would be a thin wafer of uniformly doped N-type silicon, which ultimately forms the collectors of the finished transistors. The first step in the manufacturing process is to grow, over the entire surface of this wafer, a thin layer of silicon dioxide. On top of this is laid down a photographic resist essentially similar to that used in the production of printed circuit boards. Over the wafer is placed a photographic mask which has transparent areas defining the base regions of the transistors, and through this mask the photoresist is exposed to (ultraviolet) light. The photoresist is then developed, when the exposed portions are dissolved away.

The wafer is then placed in hydrofluoric acid, which etches away the silicon dioxide where it is not protected by the photoresist, a process known as photolithography. The resist is then removed using hydrogen peroxide solution.

The next step is to place the wafer in a furnace containing a P-type

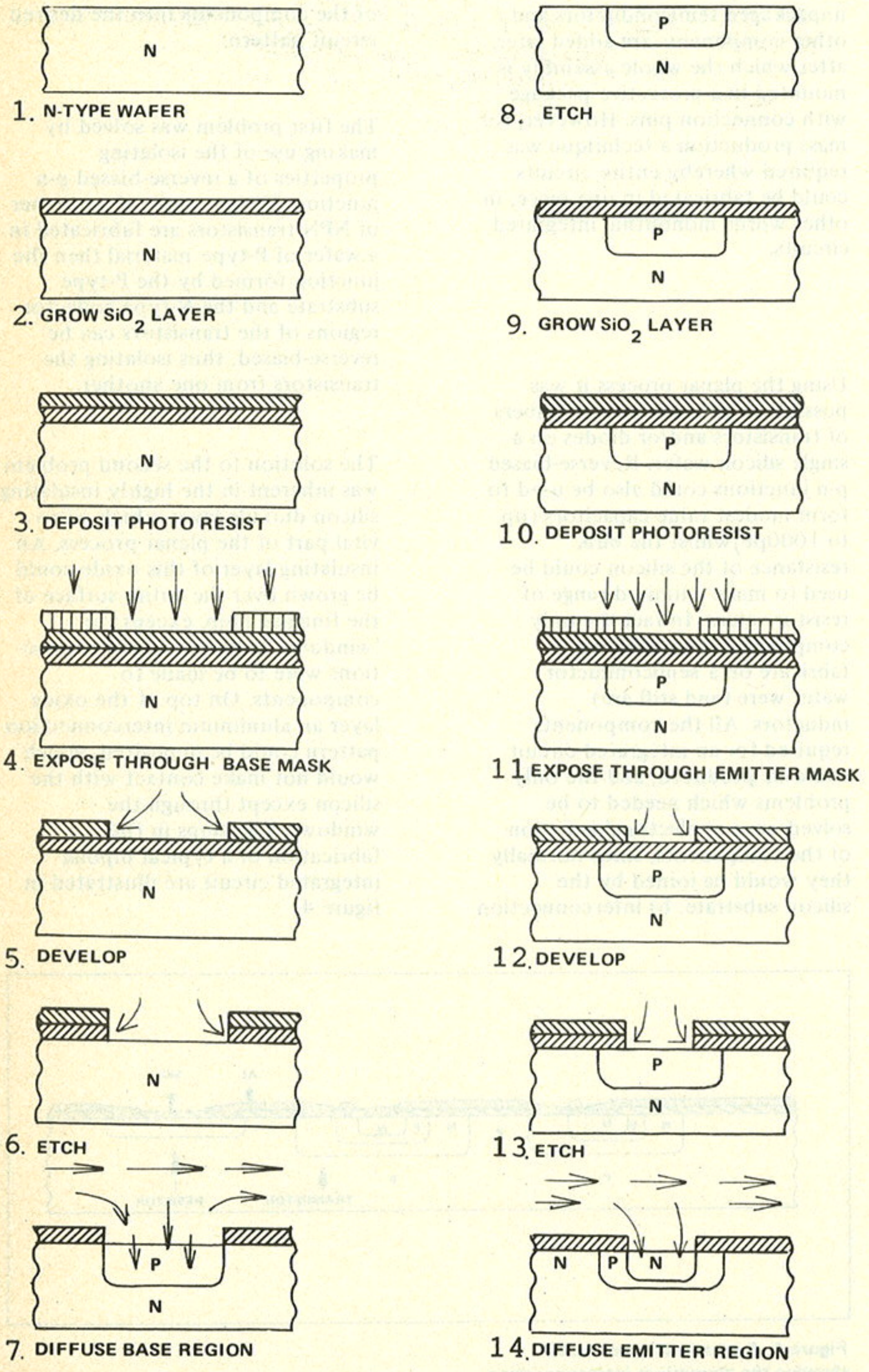

1. N-TYPE WAFER
2. GROW SiO$_2$ LAYER
3. DEPOSIT PHOTO RESIST
4. EXPOSE THROUGH BASE MASK
5. DEVELOP
6. ETCH
7. DIFFUSE BASE REGION
8. ETCH
9. GROW SiO$_2$ LAYER
10. DEPOSIT PHOTORESIST
11. EXPOSE THROUGH EMITTER MASK
12. DEVELOP
13. ETCH
14. DIFFUSE EMITTER REGION
15. ETCH
16. DEPOSIT Al LAYER
17. DEPOSIT PHOTORESIST
18. EXPOSE THROUGH CONNECTION MASK
19. DEVELOP
20. ETCH
21. REMOVE RESIST: TRANSISTORS READY TO BE TESTED

Figure 3. Fabrication of a planar transistor.

elektor supplement

dopant gas. Where the silicon dioxide has been etched away the gas diffuses into the wafer and changes the doping to P-type, thus defining the base regions of the transistors. Elsewhere the dopant does not penetrate the impervious silicon dioxide layer.

The silicon dioxide is then removed using hydrofluoric acid, a new layer is grown and the whole process is repeated using a mask to define the emitter regions, and an N-type dopant gas.

The silicon dioxide layer is again removed, a layer of aluminium is deposited over the whole surface of the wafer. This is then selectively etched away using the photolithographic process, leaving aluminium connection 'pads' to which the collector, base and emitter wires will eventually be bonded. Each transistor is then tested automatically, rejects being marked with an ink spot, after which the wafer is diced up into individual transistor 'chips' which are then packaged.

Integrated circuits

Even with the planar technique the individual transistors still had to be physically separated, packaged in a protective casing and subsequently assembled into electronic circuits. The miniaturisation requirements of the military/aerospace industries and the use of thousands of identical circuits in digital computers led to a demand for the integration of complete circuits into small packages. *Hybrid* circuits were an early attempt at integration, and indeed are still used in many applications. In a hybrid circuit resistors and 'wiring' are printed onto a ceramic substrate, whilst unpackaged semiconductors and other components are added later, after which the whole assembly is mounted in a protective package with connection pins. However, for mass production a technique was required whereby entire circuits could be fabricated in one piece, in other words monolithic integrated circuits.

Using the planar process it was possible to produce large numbers of transistors and/or diodes on a single silicon wafer. Reverse-biased p-n junctions could also be used to form modest value capacitors (up to 1000pF) whilst the bulk resistance of the silicon could be used to make a limited range of resistor values. In fact the only components impossible to fabricate on a semiconductor wafer were (and still are) inductors. All the components required for an integrated circuit could be produced, and the only problems which needed to be solved were a) electrical isolation of the components, since normally they would be joined by the silicon substrate. b) interconnection of the components into the desired circuit pattern.

The first problem was solved by making use of the isolating properties of a reverse-biased p-n junction. For example, if a number of NPN transistors are fabricated in a wafer of P-type material then the junction formed by the P-type substrate and the N-type collector regions of the transistors can be reverse-biased, thus isolating the transistors from one another.

The solution to the second problem was inherent in the highly insulating silicon dioxide layer which was a vital part of the planar process. An insulating layer of this oxide could be grown over the entire surface of the finished chip, except for 'windows' at points where connections were to be made to components. On top of the oxide layer an aluminium interconnection pattern could be deposited, which would not make contact with the silicon except through the windows. The steps in the fabrication of a typical bipolar integrated circuit are illustrated in figure 4.

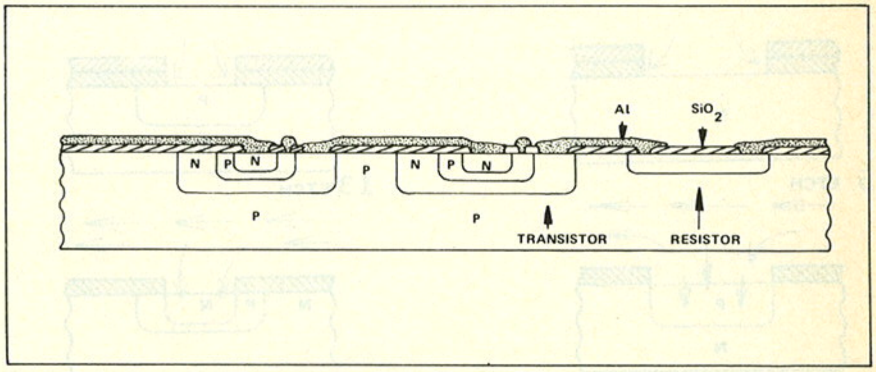


Figure 4. A cross-section of an IC showing the aluminium interconnection pattern on top of an insulating layer of silicon dioxide.

The first successful monolithic integrated circuits were developed around 1959 and the 1960s saw a rapid growth in the quantity, variety and complexity of ICs, with an equally dramatic fall in cost. If the 1950s was the decade of the transistor, then the 1960s was certainly the decade of the IC. The rate of increase in the complexity of ICs since their inception has been absolutely staggering. Taking 1959 as the starting point, up to which time only single transistors could be made, the maximum number of components in an IC (i.e. the most advanced IC for a particular year) has doubled every year. This exponential growth, which is illustrated in figure 5, shows no signs of decreasing and probably will not until the physical limitations of IC manufacturing technology are reached

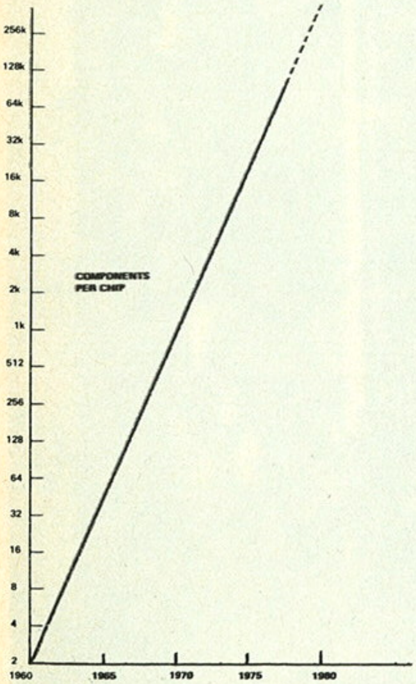


Figure 5. This graph shows how the complexity of ICs has doubled every year since 1959.

MOS ICs

Early integrated circuits utilised exclusively bipolar transistor technology, and indeed many still do. Whilst the power consumption of bipolar ICs was many orders of magnitude less than that of valves it was still appreciable, especially in complex ICs. The development of ICs based on Metal Oxide Semiconductor Field Effect Transistors (MOSFETs) allowed the production of complex (Large Scale Integration or LSI) circuits in milliwatts. Until the early 1970s the effect of ICs on the consumer market had largely been to replace functions previously performed by discrete components, for example the integration of audio amplifiers, TV i.f. amplifiers and colour decoders, and so on.

The introduction of MOS LSI technology allowed the creation of new types of consumer products, and the mid 1970s saw a proliferation of pocket calculators, digital watches and TV games which marked the beginning of the swing from linear to digital circuits in consumer electronics.

Memories

Computers require large amounts of memory in which to store data. Until the advent of semiconductor memories the usual form of memory was magnetic core store, backed up by magnetic tape or disc for long term storage. With the advent of semiconductor memories, the size and cost of data storage systems fell dramatically. Since their cost can be measured in terms of 'price per bit', semiconductor memories provide a useful indicator to the downward trend of IC costs, as shown in figure 6. The complexity of memories has also increased greatly. Whereas a few years ago, a memory capable of storing 1k (1024 bits) of data was considered as 'state-of-the art' 4k and 16k memories are now commonplace, whilst 64k, 256k and 1M (one million bit!) memories are confidently predicted. The rapidly falling cost of electronic data storage will undoubtedly have a profound influence on life in the 1980s and beyond.

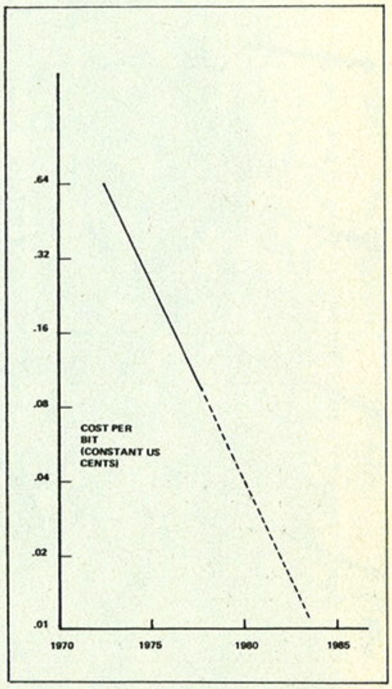
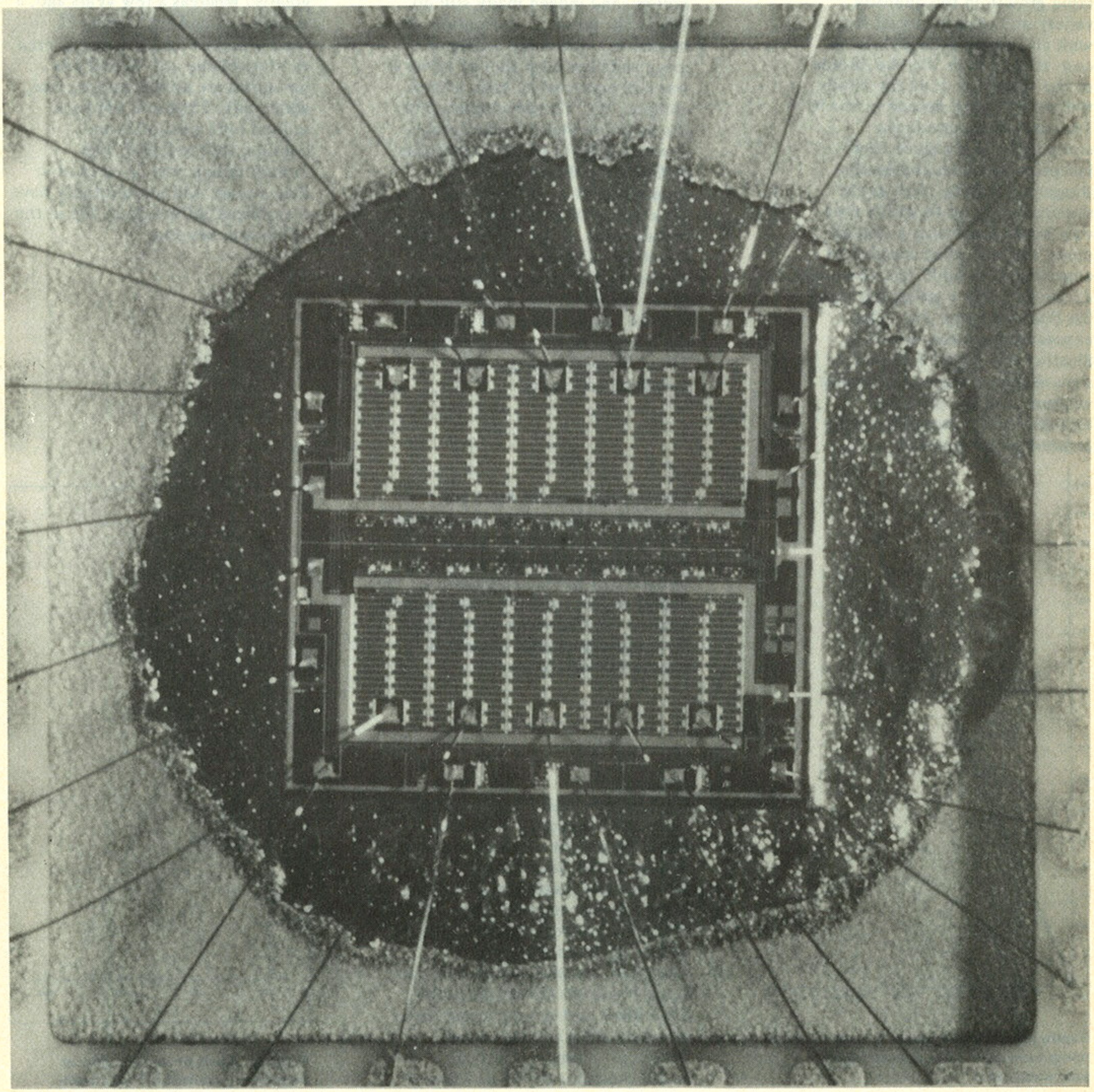


Figure 6. Costs of semiconductor memories have fallen dramatically.

elektor supplement

Figure 7. The 'chip' of a memory IC.



FML-EAST ANGLIA'S FASTEST GROWING COMPONENT SHOP

FML

FRASER-MANNING LTD., 26 HERVEY STREET, IPSWICH, SUFFOLK. IP4 2ES
Shop open 12 noon-8pm Tues-Sat (Closed Sun & Mon).
All prices include VAT.
POSTAGE FREE on orders over £2 otherwise 25p extra.
Export please add 10% to cover Post and Packing.
Payment by Cash, Cheque, PO, Barclaycard.
Quantity and trade enquiries welcomed.
FREE CATALOGUE, send 25p to cover postage.
Data Sheets available on any item, 10p each.
Barclaycard 'phone order service available. Remember it's cheaper to 'phone after 6pm!

We stock nearly everything for the home constructor-our motto-if we haven't got it we will try to get it!!

TELEPHONE
0473
50975

SWITCHES

STANDARD TOGGLE

SPST 1.5A	39p
DPDT 1.5A	54p
SPST 15A	89p
DPST	£1.03

ROCKER (10A 250V a.c.)

SPST White or Black	26p
DPST White or Black	47p
Illuminated SPST	79p
Illuminated DPST	£1.24

SLIDE (1A 250V a.c.)

DPDT Miniature	15p
DPDT Standard	16p

FOOT (Successional Action)

DPST	95p
DPDT	£1.35

(Rotary Make-a-Switch parts available)

MINIATURE TOGGLE

SPST 2A	65p
SPDT 2A	69p
DPDT 2A	79p
DPDT centre off	93p

ROTARY (100mA 250V a.c.)

1 pole 12 way (adjustable)	54p
2 pole 6 way (adjustable)	54p
3 pole 4 way (adjustable)	54p
4 pole 3 way (adjustable)	54p

MINIATURE PUSH BUTTON

Push to Make (Test)	20p
Push to Break (Test)	25p
SPST 2A 250V a.c.	89p
SPDT 2A 250V a.c.	96p

INDUCTORS

MINIATURE CAMBION

1	uH	350mA	30p
10	uH	180mA	30p
22	uH	190mA	35p
47	uH	165mA	35p
100	uH	125mA	35p
220	uH	73mA	45p
470	uH	50mA	45p
1mH		38mA	45p

REPANCO

5uH	33p
1.5mH	39p
2.5mH	39p
5.0mH	44p
7.5mH	45p
10mH	46p

COIL FORMERS

3/16"	Former complete with base, core and can	39p
1/4"	Former and core	12p
3/8"	Former and core	12p

SUPPRESSORS

Mains Transient 245V nominal	60p
Capacitor type for small mains motors	77p
Anti-parasitic Bead (2mm hole)	02p
VHF Chokes 5uH-1A	15p
VHF Chokes 4uH 3A	22p

INDICATORS

7 SEGMENT LED DISPLAYS

0.3"	RED 14 pin DIL, Left Hand Decimal Point	90p
0.6"	RED 18 pin DIL, Left Hand Decimal Point	£1.73
0.5"	RED DOUBLE DIGIT, Right Hand Decimal Point	£1.99

3mm LED's		5mm LED's	
RED	11p	RED	11p
GREEN	29p	GREEN	29p
YELLOW	29p	YELLOW	29p
CLIPS for above	3p	CLIPS for above	4p

Pack of 10 assorted 2nd grade LED's only 89p

NEON INDICATORS

RED or AMBER	31p	GREEN	52p
Wire ended Neon (90V)	14p		

LAMPHOLDERS & BULBS

LES Panel Type 8mm LENS in 6 colours	23p
LES Panel Type 10 mm LENS in 4 colours	23p
Clip on Lampholder MES 6p LES	6p
Most MES, LES & MBC bulbs available each	15p

OPTO DEVICES

Light dependent resistor (ORP12 type)	60p

THYRISTORS & TRIACS

TRIACS

6A	100V	53p
6A	400V	83p
10A	400V	£1.20

DIACS

BR100	25p

THYRISTORS

0.6A	.100V	(TO18)	30p
1A	50V	(TO39)	27p
1A	400V	(TO39)	48p
3A	50V	(TO66)	36p
5A	400V	(TO66)	60p
5A	400V	(T220)	60p
5A	800V	(T220)	90p
10A	400V	(STUD)	80p
10A	600V	(STUD)	£1.10
16A	600V	(STUD)	£1.20

KNOBS

PUSH ON KNOBS (for ¼" shafts)

Ideal for mixers and synthesisers etc. These knobs have a black base which is approx 15mm in diameter and 18mm high. The knob has a shoulder of 19mm from the base with a recess to hide the potentiometer nut.

The knobs are supplied with coloured caps which have a line to give positional indication.

Cap colours:– Red, Black, Green, Blue, Yellow and Grey. (Please specify colour required)

PRICE ONLY 19p

(Quantity prices:– 100 off 17p, 500 off 15p, 1000 off 12p each)

INSTRUMENT KNOBS (for ¼" shafts) (all screw fixing)

30mm dia. Black and aluminium finish with skirt calibrated 0 – 9	35p
36mm dia. Black and aluminium finish with skirt calibrated 0 – 10	40p
30mm dia. Black and aluminium finish with pointer ONLY	22p
44mm dia. Black and aluminium finish	40p
Black pointer knob 1¼" length	21p

DECORATIVE KNOBS (for ¼" shafts)

28mm dia. Spun aluminium finish, push fixing	30p
Spun aluminium outer with black top, screw fixing sizes:– 28mm 23mm & 18mm	40p each
Spun aluminium with black grip band, screw fixing sizes:– 28mm 23mm & 19mm	40p each

SLIDER KNOBS

MIXER TYPE – Ideal for mixers & synthesisers etc.
This is a plastic knob with a line across the centre. Size 11 x 18 x 13mm high and fits 6 x 2mm slider shafts (either horizontally or vertically). Available in SEVEN COLOURS:– Green, Black, Red, Grey, Yellow, Blue and White.

PRICE 15p each

(Quantity prices:– 100 off 13p, 500 off 11p, 1000 off 9p each)

Plain BLACK type – 15 x 12 mm	13p each
BLACK with WHITE LINE – 17 x 13 mm	13p each
CHROME type 1 – 6 x 12 mm	13p each
CHROME type 2 – 11 x 13 mm (black decor)	19p each

Other knobs are available on request.

CAPACITORS

AXIAL ELECTROLYTICS (Double ended miniature insulated)

VALUE	VOLTAGE 6.3V	10V	16V	25V	40V	63V	100V	.450V
0.47uF	05p	05p	06p	06p	06p	06p	06p	
1	06p	06p	06p	06p	06p	06p	06p	–28p
2.2	06p	06p	06p	06p	06p	06p	12p	28p
3.3	06p	06p	06p	06p	06p	06p	12p	29p
4.7	06p	06p	06p	06p	06p	06p	12p	36p
10	06p	06p	06p	06p	06p	12p	13p	47p
22	06p	06p	06p	06p	12p	12p	20p	56p
33	06p	06p	06p	06p	12p	20p	22p	79p
47	06p	06p	06p	06p	16p	20p	28p	82p
100	08p	08p	08p	18p	19p	30p	36p	£1.45
220	12p	12p	12p	26p	38p	44p	50p	
330	17p	17p	17p	26p	49p	54p	£1.05	
470	13p	13p	18p	23p	46p	66p	£1.10	
1000	19p	21p	23p	24p		69p		
2200		69p		69p		99p		
4700		69p	96p					

Please specify exact value and voltage required.
Remember larger voltage larger size.

PCB ELECTROLYTICS (Single ended miniature insulated)

VALUE	VOLTAGE 10V	16V	25V	40V	63V
0.47uF					14p
1					14p
2.2					14p
3.3					14p
4.7					14p
10		14p			15p
22	14p	14p			15p
33	14p	14p			15p
47	14p	14p			15p
100	14p	15p			26p
220	16p	17p			30p
330	19p	23p			45p
470	21p	24p			
1000	29p	31p	39p	49p	

POLYESTER
(250Va.c. E6 Series)

0.01uF to 0.22uF	5p
0.33, 0.47uF	9p
0.68uF	12p
1.0uF	15p
1.5uF	22p
2.2uF	25p

VARIABLE CAPACTIORS

300pF Dielectric type Jackson	£1.59
500pF Dielectric type Jackson	£1.82
10–365pF Air spaced Jackson	£2.67
Dual version of above type 02	£3.15
10pF Air spaced ¼" spindle	£1.67
25pF Air spaced ¼" spindle	£1.67
50pF Air spaced ¼" spindle	£1.89
100pF Air spaced ¼" spindle	£2.13

POLYSTYRENE
(63V E12 Series)

10pF to 15,000pF	8p

CERAMIC
(Mullard 600 type miniature)

1.8pF to 330pF (E12 2%)	5p
390pF to 4700pF (E12 10%)	5p
1nF to 22nF (E3 80%)	5p

TRIMMERS

2–10pF Poly (miniature)	20p
2–22pF Poly (miniature)	24p
5.5–65pF Poly (miniature)	30p
3–30pF Beehive (air)	19p
3–10pF Mica compression	21p
20–250pF Mica compression	30p
50–450pF Mica compression	36p
150–750pF Mica compression	44p

DISC CERAMIC

Low voltage		
0.01uF	18V	8p
0.047	12V	8p
0.1	18V	10p
0.1	30V	12p
High voltage	750V dc	
0.001uF		5p
0.01		8p

CASES & BOXES

ALUMINIUM BOXES

3" x 2" x 1"	49p	5¼" x 2¾" x 1½"	68p
4" x 4" x 1½"	69p	4" x 2¾" x 1½"	67p
4" x 2½" x 2"	75p	5¼" x 4" x 1½"	79p
7" x 5" x 2½"	£1.19	6" x 4" x 2"	£1.08
8" x 6" x 3"	£1.58		

INSTRUMENT CASES (Metal RS type)

Attractive cases ideal for instrument or power supplies.
Two tone Blue and Cream finish

3" x 5½" x 2"	£2.05	4" x 7" x 3"	£2.29
5" x 8½" x 3¾"	£3.46		

VINYL COVERED METAL INSTRUMENT CASES

6" x 4¾" x 1¾"	£1.67	8" x 5¼" x 2"	£1.96
9" x 5¾" x 2½"	£2.25	11" x 6" x 3"	£2.71

(We make no extra charge for post and packing on orders over £2 in value)

PLASTIC BOXES

Vero PB10 3" x 2" x 1" 45p

We also have a large stock of diecast aluminium boxes, sloping ABS cases and several VERO cases. Please send for our catalogue (25p) if you do not see what you require in our advertisement.

WE ARE STOCKISTS OF

... THE FOLLOWING MANUFACTURERS GOODS

RS Components Ltd, ITT Components, National Semiconductor, Texas, Sifam, RCA, Bulgin, Motorola, Lorlin, Mullard, Antex, Vero etc.

If you require components not shown in our advert or catalogue we still may be able to supply it – Please phone us and ask.

WATCH THIS SPACE

IT'S BARGAIN CENTRE

2N3055	33p each
TIP31 or TIP32	39p each
TIP41 or TIP42	39p each
0.022uF polyester	3p each
0.33uF polyester	6p each
22uF 450V electrolytic	19p
47uF 25V electrolytic	5p
680uF 16V electrolytic	12p
RED LEDs (5mm)	10 for £1.00

ALL COMPONENTS ARE BRAND NEW AND GUARANTEED. ONLY AVAILABLE AT THESE PRICES WHILST STOCK LAST.

RESISTORS

PRICE REDUCTIONS

CARBON FILM (Miniature)

0.25W E24 series 10R – 1M 5%	1p each
0.5W E24 series 10R – 10M 5%	1p each
Pack of E12 series 10 of each value (610 total)	£6.00
Pack of E24 series 10 of each value (1210 total)	£12.00
Expansion Pack E12 to E24 series (600 total)	£6.00
(PLEASE SPECIFY 0.25W OR 0.5W)	
1W E12 series 10R – 10M 5%	5p each
2W E12 series 10R – 10M 5%	9p each

METAL OXIDE

0.5W E24 series 10R – 1M 2%	3p each

WIRE WOUND

2.5W E12 series 0.22R – 270R	25p each
4W E6 series 1R – 10K	25p each
7W E12 series 1R – 22K	25p each
11W E6 series 1R – 22K	25p each
17W E6 series 1R – 22k	25p each

THERMISTORS

Equiv. CZ4 650R to 37R Hot 0.3A	40p
Equiv. VA1026 or CZ13A 370R to 28R Hot 0.3A	40p
Equiv. VZ1104 or OD10 100R to 1R Hot 2.2A	40p

ROTARY POTENTIOMETERS (RS Type)
Carbon track, ± 20%, insulated ¼" spindle

LINEAR (0.5W) 5K–1M	35p each
LOG (0.25W) 5K–2M	35p each
DP Switched Lin 25K–500K	70p each
DP Switched Log 5K–1M	70p each

OPEN PRESETS (0.1W)

E3 series 100R–4.7M Vert. or Horiz.	8p each

COMPONENT TRAYS

Measuring approx. 14" x 9" x ¾" and divided into 16 compartments, these Bextrene trays are ideal for storing resistors etc.

INTRODUCTORY PRICE ONLY 79p each

JOYSTICK CONTROLS

2 dimension AB type (2 pots)
100K version £1.95 to 220K version £1.95

SEMICONDUCTORS

RECTIFIER DIODES

1N4001	50V	1A	4p
1N4002	100V	1A	5p
1N4003	200V	1A	6p
1N4004	400V	1A	7p
1N4005	600V	1A	8p
1N4006	800V	1A	9p
1N4007	1000V	1A	9p
1N5400	50V	3A	15p
1N5401	100V	3A	16p
1N5402	200V	3A	18p
1N5404	400V	3A	19p
1N5406	600V	3A	24p
1N5407	800V	3A	25p
1N5408	1000V	3A	29p

SIGNAL DIODES

OA47	9p	OA202	8p
OA90	6p	1N914	5p
OA91	6p	1N4148	4p

ZENER DIODES

400mW	1.3V to 39V	9p
1.3mW	1.3V to 100V	23p

LINEAR I.C.s

CA3046 array	90p
CA3089 IF system	£2,30
CA3090 stereo D	£4,25
LM324 Quad Op. Amp	98p
LM380 2W amp	£1,05
LM381 stereo preamp	£1,80
LM3900 quad amp	84p
MC1310 stereo D	£1,29
555 Timer	39p
556 Dual Timer	£1,05
566 VCO	£1,80
709 Dil Op Amp	30p
711 Comparator	38p
723 150 mA regulator	60p
741 Op Amp	24p
748 Op Amp	42p
SN76013 Audio Amp	£1,95
SN76023 Audio Amp	£1,95
TAA550B Stabiliser	42p
TBA641 Audio Amp	£2,70
TBA800 5W Amp	98p

TRANSFORMERS

MAINS (240V primary)

GENERAL PURPOSE

6–0–6V	100mA	98p
9–0–9V	75mA	98p
12–0–12V	100mA	£1.13
0–6 0–6V	280mA	£2.00
0–12 0–12V	150mA	£2.00
0–4.5 0–4.5V	600mA	£2.48
0–6 0–6V	500mA	£2.48
0–12 0-12V	250mA	£2.48
0–15 0–15V	220mA	£2.48
0–20 0–20V	150mA	£2.48
0–6V	3.3A	£3.04
0–9V	2.2A	£3.04
0–12V	1.6A	£3.04
0–18V	1.1A	£3.04
0–24V	800mA	£3.04
6–0–6V	1½A	£3.80
9–0–9V	1A	£2.98
12–0–12V	1A	£3.60
15–0–15V	1A	£3.96
30–0–30V	1A	£4.99

GOOD REGULATION
(Typically better than 10%)

0–4.5 0–4.5V	600mA	£2.90
0–6 0–6V	500mA	£2.90
0–12 0–12V	250mA	£2.90
0–15 0–15V	200mA	£2.90
0–20 0–20V	150mA	£2.90
0–4.5 0–4.5V	2.2A	£4.60
0–6 0–6V	1.6A	£4.60
0–12 0–12V	800mA	£4.60
0–15 0–15V	600mA	£4.60
0–17.50–17.5V	500mA	£4.60
0–20 0–20V	500mA	£4.60
0–4.5 0–4.5V	5.5A	£7.14
0–6 0–6V	4.1A	£7.14
0–12 0–12V	2A	£7.14
0–15 0–15V	1.6A	£7.14
0–20 0–20V	1.2A	£7.14
0,19,25,33,40,50V	½A	£6.97
0,19,25,33,40,50V	1A	£7.96
0,19,25,33,40,50V	2A	£9.99

Prices include postage and packing

This Bi-monthly Advertisement only shows some of our stock.
Send 25p for Catalogue or phone for items not shown here e.g. TTL, CMOS, TRANSISTORS, CONNECTORS, CABLE etc.

ALL PRICES INCLUDE VAT

WHY NOT USE BARCLAYCARD-YOU PHONE-WE SEND

elektor supplement

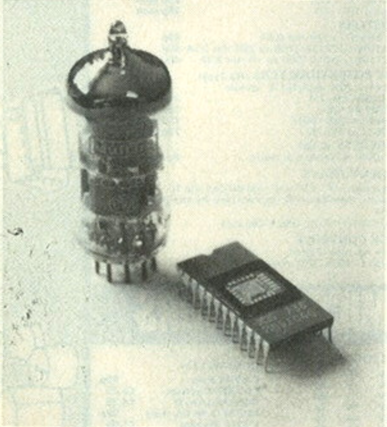


Figure 8. A Read Only Memory IC (ROM) which can store 4096 bits of data, compared with a double triode valve which could, if used as a memory element, store one bit.

Microprocessors

Mention the word 'microprocessor' to many people and they will immediately think of 'home computers', but a microprocessor is much more than just this. Of course a microprocessor can be used as the central processor in a small computer system, and for a few hundred pounds one can purchase a system with the processing power of a large computer of the 1960s. However, the majority of applications for uPs are likely to be in *dedicated* systems. It has long been known that electronic circuits could replace mechanical and electromechanical functions in many types of equipment. To take a mundane example, the cam-timer in an automatic washing machine could be replaced with an electronic timer and some logic circuits in an IC package. However, to design an IC specifically for this purpose would be uneconomic, and if any design change was required at a late stage in the development this would mean developing a different IC, which would be out of the question. A microprocessor, on the other hand, can be used in a wide variety of control applications simply by changing its programme, which can be stored in an inexpensive Read Only Memory (ROM). This gives great flexibility during the design phase and also offers the possibility of modifications at a later date without any of the retooling costs involved in changing a mechanical part. This illustrates the superiority of a *software* approach.

The future

What of the future? The advent of VLSI (Very large Scale Integration) with ever increasing numbers of electronic functions on a single chip means that electronics are entering into more and more fields which previously were cost-prohibitive. The introduction of electron beam and X-ray techniques in the fabrication of microelectronic circuits is expected to lead to a further increase in the bit density of memories by a factor of 100, with only minor increases in cost. There will be few areas of our life, which ultimately will not be touched by this electronic revolution. The μP-controlled washing machine, sewing machine, and oven are already with us. They can be expected to take over the control of thermostats in central heating and solar energy systems, refrigerators, burglar and fire alarms etc. Microprocessors are already incorporated in automobiles, controlling exhaust emission and ignition timing, thus improving fuel economy, and in the near future they will be connected to safety devices such as anti-skid sensors. In industry, microprocessors are increasingly appearing on the shop floor in a wide variety of adaptive control processes, hopefully freeing many workers from boring and repetitive jobs. In education and leisure activities the microprocessor is a powerful learning tool. Children may well become as familiar with the CRT of their μP terminal as their parents were with the sight of their teachers. The home computer offering computing capability equal to that provided by the most powerful main-frame of only a few years ago is now available for no more than the cost of a colour TV set or a stereo system.

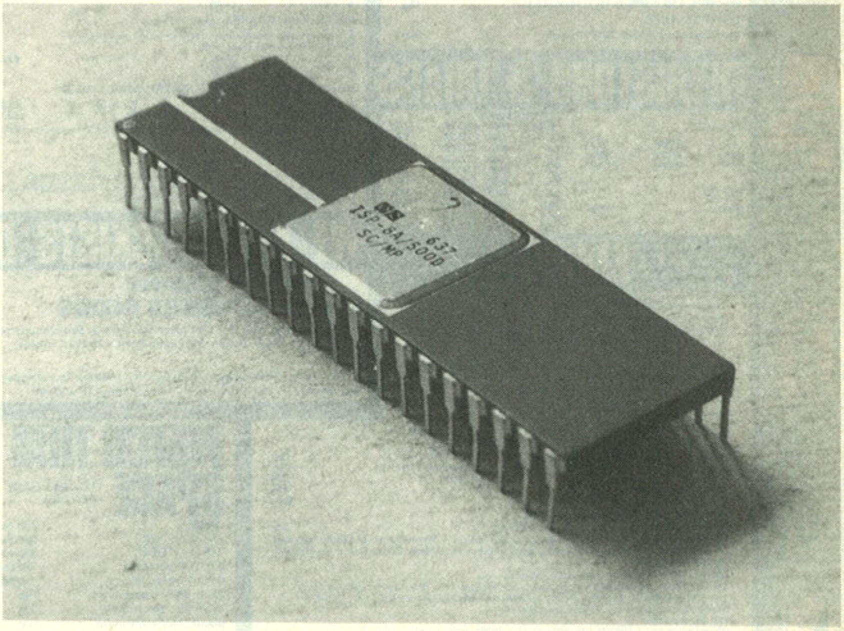


Figure 9. A typical microprocessor IC which is probably as powerful as the largest valve computer ever built.

Perhaps the greatest impact of microprocessors and semiconductor memories however, will be the so-called 'paperless information revolution'. Teletext is already here – and Viewdata almost. The introduction of these two services could mark the beginning of a change in the lifestyles of a large percentage of the population, as the domestic TV set becomes more than just a box on which to watch the offerings of the TV companies. For example, why travel for half an hour or more on a crowded bus to do the shopping when one can simply select and order goods from a catalogue displayed on the TV screen? (Will this bring the demise of the high street shop?) Why commute 100 miles or more to the office when the same work could be done at home using the TV to call up the necessary data? Why watch boring repeat programmes when one could play chess with a friend (or a computer) hundreds of miles away? The list of speculations for a data network using the TV screen as a data terminal are virtually endless. However, bringing the world into one's living room in this way is certain to entail profound sociological changes. Will we become passive conditioned consumers of the products fed onto our screens by those who control the information media. Will there be increasingly less social contact between people? Will the TV end up watching us? Fanciful though it may seem, remember that nineteen eighty-four is not far away!

Semiconductor manufacturer directory.
The following is a list of some of the main semiconductor manufacturers whose products are distributed in the U.K. The manufacturers should be able to provide further details regarding local representatives/distributers in your area.

AEI Semiconductors
Carholme Road,
Lincoln.
LN1 1SG
Tel: 0522 29992

A E G Telefunken
Bath Road,
Slough.
SL1 4AW
Tel: 0753 87210

Analog Devices
Central Avenue,
East Molesey,
Surrey.
Tel: 01-941 0466

Advanced Micro Devices
Ebury Gate,
23 Lower Belgrave Street,
London. S.W.1
Tel: 01-730 0855

AMI Microsystems
108a Commercial Road,
Swindon,
Wiltshire.
Tel: Swindon 31345

Fairchild Semiconductor Ltd.
Kingmaker House,
Station Road,
New Barnet,
Herts.
EN5 1NX
Tel: 01-440 7311

Ferranti
Fields New Road,
Chadderton,
Oldham.
OL9 8NP
Tel: 061-624 0515

GEC Semiconductors Ltd.
East Lane,
Wembley,
Middlesex.
HA9 7PP
Tel: 01-904 9303

General Instrument Microelectronics Ltd.
57/61 Mortimer Street,
London. W1N 7TD
Tel: 01-636 2022

Intel Corp. (U.K.) Ltd.
Broadfield House,
4 Between Towns Road,
Cowley,
Oxford.
Tel: 0865 771431

Intersil Inc.
8 Tessa Road,
Richfield Trading Estate,
Reading,
Berkshire.
Tel: 0734 595011

Mostek U.K. Ltd.
Masons House,
1 Walley Drive,
Kingsbury Road,
London. N.W.9
Tel: 01-204 9322

Motorola Ltd.
York House,
Empire Way,
Wembley,
Middlesex.
Tel: 01-902 8836

Mullard Ltd./Signetics
Mullard House,
Torrington Place,
London. WC1E 7HD
Tel: 01-580 6633

National Semiconductor U.K. Ltd.
19 Goldington Road,
Bedford.
Tel: 0234 211262

Newmarket Transistors Ltd.
Exning Road,
Newmarket,
Suffolk.
Tel: Newmarket 3381

Plessey Semiconductors
Cheney Manor,
Swindon, Wiltshire.
SN2 2QW
Tel: 0793 6251

Precision Monolithic
UK representatives are:
Bourns Ltd.
Hodford House,
17/27 High Street,
Hounslow,
Middlesex.
TW3 1TE
Tel: 01-572 6513

RCA
Windmill Road,
Lincoln Way,
Sunbury-on-Thames.
Tel: 09327 85511

Rockwell
UK distributor:
Pelco Electronics Ltd.
Enterprise House,
83-85 Western Road,
Hove,
Sussex.
BN3 1JB
Tel: Brighton 0273 722155

Siliconix Ltd.
30a High Street,
Thatcham,
Newbury,
Berks.
RG13 4JG
Tel: 0635 64846

SGS-ATES (U.K.) Ltd.
Planar House,
Walton Street,
Aylesbury,
Bucks.
Tel: 0296 5977

Siemens
Great West House,
Great West Road,
Brentford.
TW8 9DG
Tel: 568 9133

Teledyne Semiconductors
Heathrow House,
Bath Road,
Cranford,
Hounslow,
Middlesex.
Tel: 01-897 2501

Texas Instruments
Manton Lane,
Bedford.
Tel: 0234 211655

Thompson-CSF
Ringway House,
Bell Road,
Daneshill,
Basingstoke.
RG24 0QG
Tel: 0256 29155

TTLs BY TEXAS

7400	13p
7401	14p
7402	14p
7403	14p
7404	17p
7405	18p
7406	32p
7407	32p
7408	19p
7409	19p
7410	15p
7411	24p
7412	20p
7413	30p
7414	60p
7416	27p
7417	27p
7420	17p
7421	40p
7422	22p
7423	34p
7425	30p
7426	40p
7427	34p
7428	36p
7430	17p
7432	30p
7433	40p
7437	35p
7438	35p
7440	17p
7441	70p
7442A	60p
7443	112p
7444	112p
7445	100p
7446A	93p
7447A	70p
7448	80p
7450	17p
7451	17p
7453	17p
7454	17p
7460	17p
7470	36p
7472	30p
7473	34p
7474	30p
7475	36p
7476	35p
7480	50p
7481	100p
7482	84p
7483A	90p
7484	100p
7485	110p
7486	34p
7489	210p
7490A	33p
7491	80p
7492A	46p
7493A	33p
7494	84p
7495A	70p
7496	65p
7497	180p
74100	130p
74104	65p
74105	65p
74107	34p
74109	55p
74110	55p
74111	70p
74116	200p
74118	130p
74119	210p
74120	110p
74121	28p
74122	48p
74123	55p
74125	55p
74126	60p
74128	75p
74132	75p
74136	75p
74141	70p
74142	200p
74145	90p
74147	190p
74148	150p
74150	100p
74151A	70p
74153	70p
74154	100p
74155	90p
74156	90p
74157	70p
74159	190p
74160	100p
74161	100p
74162	100p
74163	100p
74164	120p
74165	130p
74166	140p
74167	200p
74170	240p
74172	720p
74173	120p
74174	93p
74175	85p
74176	90p
74177	90p
74178	160p
74180	93p
74181	200p
74182	90p
74184A	150p
74185	150p
74186	700p
74190	100p
74191	100p
74192	100p
74193	100p
74194	100p
74195	95p
74196	95p
74197	80p
74198	150p
74199	150p
74221	160p
74251	140p
74259	250p
74265	90p
74278	290p
74279	140p
74283	190p
74284	400p
74285	400p
74290	150p
74293	150p
74294	200p
74298	200p
74365	150p
74366	150p
74367	150p
74368	150p
74390	200p
74393	200p
74490	225p

74LS SERIES

74LS00	22p
74LS02	22p
74LS04	22p
74LS08	22p
74LS10	24p
74LS13	45p
74LS14	100p
74LS20	22p
74LS22	28p
74LS27	38p
74LS30	22p
74LS32	40p
74LS47	90p
74LS55	30p
74LS73	50p
74LS74	40p
74LS75	50p
74LS83	110p
74LS85	100p
74LS86	40p
74LS90	90p
74LS93	90p
74LS107	45p
74LS112	100p
74LS123	75p
74LS124	180p
74LS132	120p
74LS133	60p
74LS138	60p
74LS139	60p
74LS151	100p
74LS153	60p
74LS157	60p
74LS158	120p
74LS160	130p
74LS161	100p
74LS162	140p
74LS163	140p
74LS164	120p
74LS165	80p
74LS173	110p
74LS174	110p
74LS175	110p
74LS181	320p
74LS190	100p
74LS191	100p
74LS192	140p
74LS193	140p
74LS195	140p
74LS196	120p
74LS221	100p
74LS240	245p
74LS241	245p
74LS242	245p
74LS243	245p
74LS245	300p
74LS251	200p
74LS257	120p
74LS259	175p
74LS298	249p
74LS373	200p
74LS374	195p
81LS95	160p
81LS96	160p
81LS97	160p
81LS98	160p
8T28	230p
9301	160p
9302	175p
9308	316p
9310	275p
9311	275p
9312	160p
9314	165p
9316	225p
9322	150p
9368	200p
9370	200p
9374	200p
9601	100p
9602	175p
9603	60p

INTERFACE ICs

MC1488	100p
MC1489	100p
75107	160p
75182	230p
75450	120p
75451/2	72p
75491/2	96p

C-MOS ICs

74C00	25p
74C02	25p
74C04	27p
74C08	27p
74C10	27p
74C14	90p
74C20	27p
74C30	27p
74C32	36p
74C42	110p
74C48	250p
74C73	75p
74C74	70p
74C85	200p
74C86	65p
74C90	95p
74C95	130p
74C107	125p
74C150	250p
74C151	260p
74C157	250p
74C160	155p
74C161	155p
74C162	155p
74C163	155p
74C164	120p
74C173	120p
74C174	160p
74C175	210p
74C192	150p
74C193	150p
74C194	220p
74C195	110p
74C221	175p

4000 SERIES

4000	15p
4001	17p
4002	17p
4006	95p
4007	18p
4008	80p
4009	40p
4010	50p
4011	17p
4012	18p
4013	50p
4014	84p
4015	84p
4016	45p
4017	80p
4018	89p
4019	45p
4020	100p
4021	110p
4022	100p
4023	22p
4024	65p
4025	20p
4026	130p
4027	50p
4028	84p
4029	100p
4030	55p
4031	200p
4033	180p
4034	200p
4035	110p
4040	100p
4041	80p
4042	80p
4043	90p
4044	90p
4046	130p
4047	100p
4048	55p
4049	40p
4050	49p
4051	80p
4052	80p
4053	80p
4055	125p
4056	135p
4059	600p
4060	115p
4063	120p
4066	55p
4067	400p
4068	22p
4069	20p
4070	30p
4071	22p
4072	22p
4073	22p
4075	22p
4076	107p
4081	22p
4082	22p
4093	80p
4098	107p
4411	£11
4502	120p
4503	70p
4507	55p
4510	99p
4511	150p
4514	250p
4516	110p
4518	100p
4520	100p
4528	100p
4543	180p
4553	450p
4560	250p
4583	90p
4584	90p
40014	90p
40085	200p
40097	90p
14433	£11

Our shop is only 2 mins from DOLLIS HILL Tube station. Ample car parking available.

LINEAR ICs

AM2833	400p
*AY1-0212	600p
*AY1-1313	668p
*AY1-1320	320p
*AY1-5050	212p
*AY5-1315	600p
*AY5-1317	636p
*CA3019	80p
*CA3046	70p
*CA3048	225p
CA3080E	72p
*CA3089E	225p
*CA3090AQ	375p
CA3130S	100p
CA3140E	70p
CA3160E	75p
FX209	750p
ICL7106	925p
ICL8030	340p
LM301An	36p
LM311	190p
LM318	200p
LM324	70p
LM339	90p
LM348	95p
*LM377	175p
*LM380	99p
*LM381AN	160p
*LM389N	140p
LM709	36p
LM710	50p
LM733	100p
LM741	22p
LM747	70p
LM748	35p
LM3900	70p
LM3911	130p
LM4136	120p
*MC1310P	150p
MC1458	55p
MC1495	400p
*MC1496	100p
*MC3340	160p
*MC3360	120p
*MFC4000B	120p
MK50398	750p
NE531	130p
*NE540	200p
NE543K	225p
NE555	30p
NE556	70p
NE561B	425p
NE526B	425p
NE565	130p
NE566	155p
NE567	175p
RC4151	400p
SFF96364	1450p
*SN76003N	175p
*SN76013N	140p
*SN76013ND	120p
*SN76023N	140p
*SN76023ND	120p
*SN76033N	175p
*SP8515	750p
*TBA641B11	225p
*TBA800	90p
*TBA810	100p
*TBA820	90p
*TCA940	175p
*TDA1022	600p
TL704	130p
TL084	130p
TL170	50p
XR2206	400p
XR2207	400p
*XR2216	675p
XR2240	400p
*ZN414	90p
ZN424E	135p
ZN425E	400p
ZN1034E	200p
95H90	800p

VOLTAGE REGULATORS

Fixed Plastic T0-220

1A	+ve		-ve	
5V	7805	90p	7905	120p
12V	7812	90p	7912	120p
15V	7815	90p	7915	120p
18V	7818	90p	7918	120p
24V	7824	90p	7924	120p
100 mA		T0-92		
5V	78L05	35p	79L05	80p
12V	78L12	35p	79L12	80p
15V	78L15	35p	79L15	80p

OTHER REGULATORS

LM309K	135p	TBA625B	120p
LM317T	200p	TL430	65p
LM323K	625p	78H05KC	675p
LM723	37p	78MGT2C	135p

OPTO-ELECTRONICS

2N5777	45p	ORP12	90p	ORP61	90p
OCP71	130p	ORP60	90p	TIL78	70p

0.125"		LED	0.2"	
TIL32	I.R.	75p	TIL220 Red	16p
TIL209	Red	13p	TIL222 Gr	18p
TIL211	Gr	20p	TIL228 Red	22p
TIL212	Ye	25p	MV5491 TS	120p
TIL216	Red	18p	Clips	3p

DISPLAYS

3015F		200p	FND500	120p
DL704		140p	FND507	120p
DL707	Red	140p	TIL311	600p
707	Gr	140p	TIL312/3	110p
DL747	Red	225p	TIL321/2	130p
747	Gr	225p	TIL330	140p
FND357		120p		

TRANSISTORS

AC127/8	20p
AD149	70p
AD161/2	45p
BC107/8	11p
BC109	11p
*BC147/8	9p
*BC149	10p
*BC157/8	10p
*BC159	11p
*BC169C	12p
*BC172	12p
BC177/8	17p
BC179	18p
*BC182/3	10p
*BC184	11p
BC187	30p
*BC212/3	11p
*BC214	12p
BC461	36p
BC477/8	30p
*BC516/7	50p
*BC547B	16p
*BC549C	18p
*BC557B	16p
*BC559C	18p
BCY70	18p
BCY71/2	22p
BD131/2	50p
BD242	65p
BDY56	200p
BF200	32p
*BF244B	35p
*BF256B	70p
BF257/8	32p
BF259	36p
*BFR39	30p
*BFR40	30p
*BFR41	30p
*BFR79	30p
*BFR80	30p
*BFR81	30p
BFX29	30p
BFX30	34p
BFX84/5	30p
BFX86/7	30p
BFX88	30p
BFW10	90p
BFY50	22p
BFY51/2	22p
BYF56	33p
BFY90	90p
BLY83	700p
BRY39	45p
BSX19/20	20p
*BU105	190p
*BU108	250p
*BU205	200p
*BU208	240p
*BU406	145p
MJ481	175p
MJ491	200p
MJ2501	225p
MJ2955	100p
MJ3001	225p
*MJE340	65p
MJE2955	100p
MJE3055	70p
*MPF102	45p
*MPF103/4	40p
*MPF105/6	40p
*MPSA06	30p
*MPSA12	50p
*MPSA56	32p
*MPSU06	63p
*MPSU56	78p
OC28	130p
OC35	130p
*R2008B	200p
*R2010B	200p
*TIP29A	40p
*TIP29C	55p
*TIP30A	48p
*TIP30C	60p
TIP31A	58p
TIP31C	62p
TIP32A	68p
TIP32C	82p
TIP33A	90p
TIP33C	114p
TIP34A	115p
TIP34C	160p
TIP35A	225p
TIP35C	290p
TIP36A	270p
TIP36C	340p
TIP41A	65p
TIP41C	78p
TIP42A	70p
TIP42C	82p
TIP2955	78p
TIP3055	70p
*TIS43	34p
*TIS93	30p
*ZTX108	12p
*ZTX300	13p
*ZTX500	15p
*ZTX502	18p
*ZTX504	30p
2N457A	250p
2N696	35p
2N697	25p
2N697	45p
2N706A	20p
2N708A	20p
2N918	45p
2N930	18p
2N1131/2	20p
2N1613	25p
2N1711	25p
2N2102	60p
2N2160	120p
2N2219A	20p
2N222A	20p
2N2369A	16p
2N2484	30p
2N2646	50p
2N2904/5	25p
2N2906A	24p
2N2907A	30p
*2N2926	9p
2N3053	20p
2N3054	65p
2N3055	48p
2N3442	140p
2N3553	240p
*2N3565	30p
*2N3643/4	48p
*2N3702/3	12p
*2N3704/5	12p
*2N3706/7	12p
*2N3708/9	12p
2N3773	300p
*2N3819	25p
*2N3820	50p
2N3823	70p
2N3866	90p
*2N3903/4	18p
*2N3905/6	20p
*2N4036	65p
*2N4058/9	12p
*2N4060	12p
*2N4061/2	18p
*2N4123/4	22p
*2N4125/6	22p
*2N4289	20p
*2N4401/3	27p
2N4427	90p
*2N4871	60p
*2N5087	27p
*2N5089	27p
*2N5172	27p
2N5179	27p
2N5191	83p
2N5194	90p
*2N5245	40p
*2N5296	55p
*2N5401	50p
*2N5457/8	40p
*2N5459	40p
*2N5460	40p
*2N5485	44p
*2N6027	48p
2N6247	190p
2N6254	130p
2N6290	65p
2N692	65p
3N128	120p
3N140	100p
3N201	110p
3N204	100p
40290	250p
40360	40p
40361/2	45p
40364	120p
40408	70p
40409	65p
40410	65p
40411	300p
40594	97p
40595	105p
40603	58p
40673	75p
40841	90p
40871/2	90p

DIODES

*BY127	12p
*OA47	9p
*OA81	15p
*OA85	15p
*OA90	9p
*OA91	9p
*OA95	9p
*OA200	9p
*OA202	10p
*1N914	4p
*1N916	7p
*1N4148	4p
1N4001/2	5p
1N4003/4	6p
1N4005	6p
1N4006/7	7p
1N5401/3	14p
1N5404/7	19p

BRIDGE RECTIFIERS

*1A	50V	21p
*1A	100V	22p
*1A	400V	30p
*2A	50V	30p
*2A	100V	35p
*2A	400V	45p
*3A	200V	60p
*3A	600V	72p
*4A	100V	95p
*4A	400V	100p
6A	50V	90p
6A	100V	100p
6A	400V	120p
10A	400V	200p
25A	400V	400p

***ZENERS**

2.7V-33V

400 mW	9p
1 W	15p

TRIACS PLASTIC

3A	400V	60p
3A	500V	65p
6A	400V	70p
6A	500V	88p
8A	400V	75p
8A	500V	95p
12A	400V	85p
12A	500V	105p
16A	400V	110p
16A	500V	130p

SPECIAL OFFERS

100 + 741
£16

100 + 555
£18

100 + RCA 2N3055
£36

CRYSTALS

100 KHz	300p
1 MHz	370p
3.2768 MHz	350p

THYRISTORS

1A	50V	40p
1A	400V	65p
1A	600V	70p
3A	400V	90p
8A	600V	200p
12A	400V	160p
16A	100V	160p
16A	400V	180p
16A	600V	220p
BT106		110p
C106D		45p
*MCR101		36p
2N3525		120p
*2N5060		34p
*2N5064		40p

PLEASE SEND SAE FOR FULL LIST

MEMORIES

2102	120p
2102-2	140p
2107B	600p
2111	325p
2112-2	300p
2114	1500p
5101	510p
6810	400p
AY-51013	500p
AY5-2376	1000p
RO3-2513	600p
SN74S262	1450p

ROM/PROMs

74S188	225p
74S287	400p
74S387	400p
93436	650p
93446	650p

EPROMS

1702A	550p
2708	900p
2716	3000p
4702	900p

CPUs

4040A	670p
6502	1200p
6800	900p
8080A	650p

OTHER

3205	320p
3245	400p
4201	390p
4289	970p
4801	500p
6820	600p
6850	700p
8205	320p
8212	225p
8216	225p
8224	400p
8228	575p
8251	700p
8255	550p
9905	200p
9906	275p

LOW PROFILE DIL SOCKETS BY TEXAS

8 pin	11p	18 pin	25p	24 pin	33p
14 pin	12p	20 pin	28p	28 pin	42p
16 pin	13p	22 pin	30p	40 pin	51p

WIRE WRAP SOCKETS

8 pin	30p	16 pin	55p	40 pin	120p
14 pin	40p	24 pin	80p	28 pin	100p

EDGEBOARD CONNECTORS

0.156" PITCH SOLDER TAIL
2 × 10 WAY 85p 2 × 18 WAY 120p 25 WAY 160p
2 × 15 WAY 100p 2 × 22 WAY 135p

VAT RATES All items at 8% EXCEPT marked * which are at 12½%

Please Add 25p p & p & VAT
Govt., Colleges, etc. Orders accepted

Callers Welcome Mon – Fri 9.30 – 5.30
Saturday 10.30 – 4.30

TECHNOMATIC LTD
17 BURNLEY ROAD, LONDON NW10
Tel: 01 452 1500 Telex: 922800

QUALITY COMPONENTS BY RETURN

Access

Carbon Film Resistors

High stability, low noise, 0.25W 5% E12 series from 4.7 ohms to 10 Megohms. Any selection.

each	100+	1000+	5000+
1p	0.9p	0.8p	0.75p

Special development pack of 10 of each value 4.7 ohms to 1 Megohm, a total of 650 resistors £5.70

Potentiometers

Carbon track. Log and Linear values
5K – 2M2 single gang 26p
5K – 2M2 single gang switched 60p
5K – 2M2 dual gang stereo 75p

Preset Potentiometers

Subminiature type available in horizontal or vertical mounting. 0.1W rating. 100 ohms to 2M. . . . . 6p each.

Special development of 5 of each value from 100 ohms to 2M, a total of 70 presets (please state vertical or horizontal) £3.95

Ceramic Capacitors

Miniature plate type. 50V PC mounting. Available from 22pF to 1000pF in E12 series and 1500pF to 0.047uF in E6 series. . . . . 2p each.

Polyester Capacitors

Mullard C280 series. 250V PC mounting.
0.01, 0.015, 0.022, 0.033, 0.047, 0.048, 0.1, **5p**; 0.15, 0.22, **7p**; 0.33, 0.47, **10p**; 0.068, **14p**; 1.0, **17p**; 2.2uF, **28p each.**

Special development pack of 5 of each value £6.20

Tantalum Capacitors

0.1, 0.15, 0.22, 0.33, 0.47, 0.68, 1.0, 2.2 @ 35V 9p
4.7 @ 25V, 6.8 and 10 @ 25V 13p
22 @ 16V, 47 @ 6V, 68 @ 3V, 100 @ 3V 16p
Development pack 5 of each value £8.30

Optoelectronics

LEDs

	Red	Green	Yellow
0.125 in	9p	15p	18p
0.2 in	9p	13p	18p

Displays

DL707	90p	DL704	90p

DIL Sockets

8 pin	11p	14 pin	12p	16 pin	13p	24 pin	30p

Quantity discounts on any mix TTL, CMOS and Linear Circuits 25+ 10%, 100+ 15%. All orders despatched by return. Prices VAT inclusive. Please add 30p for carriage. All components guaranteed brand new and full specification from leading manufacturers. Callres most welcome at our premises 8.30 a.m. to 6pm Monday to Saturday. All prices valid to 30th April 1979. Send 12p stamp for our new illustrated catalogue. Official orders welcome from colleges, universities, etc.

Linear Circuits by RCA, National etc.

709 DIL 14	25p
741 DIL 8	22p
741 DIL 14	35p
747C DIL 14	70p
748C DIL 8	35p
CA3011	80p
CA3014	130p
CA3018	75p
CA3020	160p
CA3028	125p
CA3035	140p
CA3036	170p
CA3042	170p
CA3043	180p
CA3046	75p
CA3052	150p
CA3054	115p
CA3075	180p
CA3080	70p
CA3081	125p
CA3089	180p
CA3090	400p
CA3123	150p
CA3130	90p
CA3140E	70p
LM300H	130p
LM301AN	28p
LM304H	70p
LM308N	65p
LM318N	125p
LM324N	50p
LM339	50p
LM380N	75p
LM381N	105p
LM382N	105p
LM1303	110p
LM3900	50p
LM3909	60p
MC1310P	150p
MC1312P	160p
MC1314P	300p
MC1315P	520p
MC1330	100p
MC1458N	45p
MC1496N	100p
NE555	25p
NE556	80p
NE560	300p
NE561B	350p
NE562B	350p
NE565A	120p
NE566B	150p
NE567B	170p
SN76003N	200p
SN76013N	140p
SN76023N	140p
SN76033N	200p
TAA621A	215p
TBA120S	65p
TBA540	200p
TBA641	240p
TBA800	70p
TBA920	320p
TCA270SQ	200p
TDA1002	450p
TDA1022	570p
TDA2020	320p
ZN414	75p

CMOS from RCA, National etc.

4000	15p
4001	15p
4002	15p
4007	15p
4008	65p
4009	35p
4010	35p
4011	15p
4012	15p
4013	35p
4015	60p
4016	35p
4017	55p
4018	65p
4020	60p
4022	55p
4023	15p
4024	45p
4025	15p
4026	95p
4027	35p
4028	52p
4029	60p
4030	35p
4040	68p
4041	80p
4042	54p
4043	55p
4046	100p
4049	28p
4050	28p
4051	55p
4052	55p
4066	40p
4068	20p
4069	16p
4070	16p
4071	16p
4072	16p
4073	16p
4075	16p
4078	16p
4081	16p
4510	70p
4511	70p
4516	65p
4518	65p
4520	65p
4585	70p

TTL from National, Texas, ITT etc.

7400	12p
7401	12p
7402	12p
7403	12p
7404	13p
7405	13p
7406	24p
7407	24p
7408	14p
7409	14p
7410	12p
7411	19p
7412	17p
7413	25p
7414	48p
7416	24p
7417	24p
7420	12p
7421	22p
7422	18p
7423	22p
7425	22p
7426	24p
7427	24p
7428	28p
7430	12p
7432	23p
7433	32p
7437	22p
7438	22p
7440	13p
7441	52p
7442	43p
7443	75p
7444	75p
7445	70p
7446	55p
7447	55p
7448	58p
7450	14p
7451	14p
7452	13p
7454	14p
7460	14p
7470	28p
7472	24p
7473	25p
7474	25p
7475	32p
7476	28p
7480	45p
7481	90p
7482	80p
7483	60p
7485	70p
7486	24p
7489	145p
7490	32p
7491	45p
7492	35p
7493	34p
7494	80p
7495	52p
7496	50p
7497	140p
74100	90p
74104	50p
74105	40p
74107	25p
74109	30p
74110	35p
74111	45p
74116	95p
74118	82p
74119	140p
74121	25p
74123	40p
74125	35p
74126	35p
74132	50p
74141	56p
74142	200p
74145	58p
74147	110p
74148	90p
74150	70p
74151	50p
74153	50p
74154	85p
74155	52p
74156	52p
74157	53p
74160	60p
74161	65p
74162	65p
74163	65p
74164	70p
74165	70p
74166	80p
74167	180p
74170	125p
74172	400p
74173	95p
74174	68p
74175	65p
74176	58p
74177	58p
74178	80p
74181	145p
74182	60p
74185	110p
74190	72p
74191	72p
74192	64p
74193	64p
74194	60p
74195	55p
74196	55p
74197	55p
74198	110p
74199	110p

Transistors

AC125	18p
AC126	18p
AC127	17p
AC128	16p
AC176	18p
AC186	24p
AD161	38p
AD162	38p
AF124	27p
AF125	27p
AF126	27p
AF127	27p
AF139	36p
AF239	40p
BC107	8p
BC107B	10p
BC108	8p
BC108B	8p
BC108C	10p
BC109	8p
BC109C	10p
BC147	7p
BC148	7p
BC149	8p
BC157	9p
BC158	9p
BC159	9p
BC167	8p
BC168	8p
BC169	8p
BC169C	9p
BC170	9p
BC171	9p
BC172	7p
BC173	9p
BC177	14p
BC178	14p
BC179	14p
BC182	10p
BC182L	10p
BC183	10p
BC183L	10p
BC184	10p
BC184L	10p
BC207	10p
BC208	8p
BC209C	10p
BC212	10p
BC212L	10p
BC213	10p
BC213L	10p
BC214	10p
BC214L	10p
BC477	19p
BC478	18p
BC479	18p
BC547	11p
BC548	10p
BC549	11p
BC550	14p
BC558	12p
BC559	13p
BCY70	14p
BCY71	14p
BCY72	14p
BD115	52p
BD131	35p
BD132	35p
BD133	44p
BD135	38p
BD136	36p
BD137	38p
BD138	38p
BD139	35p
BD140	35p
BF244B	36p
BFX29	25p
BFX84	23p
BFX87	20p
BFX88	20p
BFY50	15p
BFY51	15p
BFY52	15p
BU105	170p
BU205	140p
BU208	160p
MJ2955	98p
MPF102	36p
MPSA06	30p
MPSA56	30p
TIP29	40p
TIP29A	44p
TIP29B	40p
TIP29C	60p
TIP30	40p
TIP30A	48p
TIP30B	55p
TIP30C	70p
TIP31	50p
TIP31A	50p
TIP31B	60p
TIP31C	65p
TIP32	55p
TIP32A	60p
TIP32B	75p
TIP32C	80p
TIP33	75p
TIP33A	80p
TIP33B	103p
TIP33C	116p
TIP34	98p
TIP34A	95p
TIP34B	128p
ZTX107	14p
ZTX108	14p
ZTX109	14p
ZTX300	16p
ZTX301	16p
ZTX302	23p
ZTX303	23p
ZTX304	25p
ZTX310	13p
ZTX311	14p
ZTX314	22p
ZTX341	21p
ZTX500	16p
ZTX501	16p
ZTX502	20p
ZTX503	20p
ZTX504	25p
ZTX530	30p
ZTX550	24p
2N696	32p
2N697	12p
2N698	28p
2N699	50p
2N706	13p
2N706A	13p
2N708	20p
2N914	22p
2N918	30p
2N919	50p
2N920	54p
2N929	25p
2N930	20p
2N1131	23p
2N1132	23p
2N1302	38p
2N1303	54p
2N1304	54p
2N1613	22p
2N1671	130p
2N2160	100p
2N2243	28p
2N2297	45p
2N2368	15p
2N2369	16p
2N2484	22p
2N2846	70p
2N2904	22p
2N2094A	23p
2N2905	22p
2N2905A	22p
2N2906	22p
2N2906A	22p
2N2907	22p
2N2907A	25p
2N2926G	10p
2N2926R	8p
2N3011	22p
2N3053	18p
2N3054	50p
2N3055	50p
2N3121	25p
2N3133	25p
2N3440	80p
2N3441	120p
2N3442	135p
2N3702	8p
2N3703	8p
2N3704	8p
2N3705	9p
2N3706	9p
2N3707	9p
2N3708	8p
2N3709	8p
2N3710	8p
2N3711	8p
2N3715	10p
2N3819	22p
2N3823	65p
2N3824	75p
2N3866	55p
2N3903	8p
2N3904	8p
2N3905	8p
2N3906	8p
2N4037	30p
2N4058	12p
2N4059	10p
2N4060	12p
2N4061	12p
2N5179	50p
2N5457	22p
2N5458	30p
2N5459	32p
2N5777	50p

Diodes

OA47	10p
OA91	5p
OA200	6p
1N914	4p
1N916	5p
1N4001	4p
1N4002	4p
1N4006	6p
1N4148	3p

Regulators

7805	60p
7812	60p
7815	60p
7818	60p
7824	60p
78L05	30p
78L12	30p
78L15	30p
7905	80p
7912	80p
7915	80p
7918	80p
7924	80p
79L05	70p
79L12	70p
79L15	70p
LM309K	110p
LM317K	300p
LM323K	530p
LM723	40p

C N STEVENSON (K1) 236 High St. Bromley Kent BR1 1PQ Tel: 01 464 2951/5770

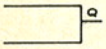
TTL and CMOS data

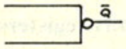
Logic ICs – general information

Logic conventions, symbols and abbreviations.

1. Positive logic is used throughout. An input or output is inactive low (0) and active high (1)
2. An inverted input or output is the opposite of the above active low and inactive high. In the pinout charts inverted functions are shown by a circle at the input or output connection and by a bar over the name of the function.

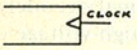
Thus:

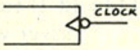




2. When an input does not react to a static input level (0 or 1) but to a transition from 0 to 1 (positive-edge triggered) then is is denoted in the pinout charts by a triangle at the input connection. Negative-edge triggering (1 to 0 transition) is denoted by the triangle plus a circle to denote inversion.

Thus:





3. The following abbreviations are used in the pinout charts:

CK = clock
CLR = clear
IC = internal connection (pins so marked are connected to the circuit within the IC but must not be connected to anything external to the IC)
NC = no connection (pins so marked are not connected to the circuit within the IC)

4. For circuits such as counters having several inputs and/or outputs the letters A and Q_A are used to denote the least significant bit and higher letters in the alphabet denote more significant bits. For example the 74191: Q_A is the least significant bit of the counter output whilst Q_D is the most significant bit.

5. Definition of terms

set : a 1 at a set input makes the corresponding output 1.
clear, reset : a 1 at a reset input makes the corresponding output 0.
preset, load : a 1 at a load input makes the output assume the same value as the data input.
enable : a 1 at an enable input causes the logic circuit to function.
latch enable : a 1 at a latch-enable input causes the input data to be 'frozen' (at the output of a latch).
strobe : a 1 at a strobe input causes the output to follow the input data (thus latch enable = strobe)
inhibit : a 1 at an inhibit input disables the logic circuit so that the output is fixed and is no longer a function of the input variables.

All the above terms of course have their inverted versions; thus, for example, when a $\overline{\text{set}}$ input is 0, the corresponding output becomes 1.

TTL ICs – electrical characteristics

recommended supply voltage range:
4.75 5.25V
input voltage range :
maximum 5.5V
minimum 0.5V
logic levels:

$$\text{output}\begin{cases}1 & 2.4\text{V}\\0 & 0.4\text{V}\end{cases}$$

$$\text{input}\begin{cases}1 & 2\text{V}\\0 & 0.8\text{V}\end{cases}$$

Input and output currents (fan-in, fanout)

For a standard TTL input such as the 7400 the input currents are as follows:

high (logic 1 = 2.4V) : 40μA
low (logic 0 = 0.4V) : -1.6mA

The direction of positive current flow is taken as being into the IC, therefore '-1.6mA' indicates that current flows out of an input in the low state. An input having these characteristics is said to be one standard TTL load or to have a fan-in of 1. The drive capability of TTL outputs is defined in terms of the number of standard loads it can drive. A normal TTL output can supply a current of -400μA in the high output state and 16mA in the low state. It can thus drive 10 standard loads and is said to have a fanout of 10.

Most TTL IC's have a fan-in of 1 and a fanout of 10. Where the fan-in and/or fanout differ from these values then this is indicated on the pinout diagram. In some cases the fan-in or fanout may be different in the high and low output states, and in such cases the 'worst case' value is given, i .e. the higher value in the case of fan-in and the lower value in the case of fanout.

For example: fan-in (high) = 3, fan-in (low) = 5; fan-in is given as 5. Fanout (high) = 20, fanout (low) = 25; fanout is given as 15.

Other TTL families

In addition to the standard 74–TTL family there are several other TTL families low-power (74L), low-power Schottky (74LS), Schottky (74S) and high-speed (74H) TTL. Many of the standard TTL functions are available in these other families. The input and output currents of these families differ from those of standard TTL and when interconnection between different families is to be made then the manufacturers' data should be consulted to check drive capability. However, when used with devices of the same family the fan-in and fanout figures given in the pinout charts apply.

Unused inputs

Unused TTL inputs assume logic 1 level and may be left floating if a high level is required at the unused input. However, for better noise immunity it is best to tie unused inputs to positive supply via a 1 k resistor, which will limit input current if any transients appear on the supply line. If an unused input is to be at logic 0 then it is simply connected direct to the 0V supply rail.

Interfacing TTL to CMOS

TTL IC's will drive CMOS IC's direct, provided that the CMOS supply voltage is the same as that for the TTL circuits (+5V). To ensure that the logic 1 output voltage of the TTL circuit is sufficiently high, connect a 2K2 pullup resistor between the output and +5V.

TTL Logic ICs – numerical index of popular types

7400 quadruple 2-input NAND gate
7401 quadruple 2-input NAND gate with open-collector outputs
7402 quadruple 2-input NOR gate
7403 as 7400 but open-collector outputs
7404 hex inverter
7406 as 7404 but open-collector, high-voltage outputs (max 30V, fanout = 25)
7408 quadruple 2-input AND gate
7409 as 7408 but open-collector outputs
7410 triple 3-input NAND gate
7411 triple 3-input AND gate
7412 as 7410 but open-collector outputs
7413 dual 4-input NAND Schmitt trigger
7414 hex inverting Schmitt trigger
7416 as 7404 but with open-collector, high-voltage outputs (max 15V, fanout = 25)
7420 dual 4-input NAND gate
7428 as 7402 but power driver (fanout = 30)
7430 8-input NAND gate
7437 as 7400 but power driver (fanout = 30)
7440 as 7420 but power driver (fanout = 30)
7445 BCD-to-decimal decoder/driver
7447 BCD-to-7-segment decoder/driver
7470 AND-gated positive-edge triggered JK flip-flop with preset and clear
7472 AND-gated JK flip-flop with preset and clear
7473 dual JK flip-flop with clear
7474 dual D positive-edge triggered flip-flop with preset and clear
7475 4-bit bistable latch
7476 dual JK master-slave flip-flop with preset and clear
7485 4-bit comparator
7486 quadruple 2-input exclusive-OR gate
7489 64-bit read/write memory
7490 decade counter
7492 divide-by-12 counter
7493 4-bit binary counter
7495 4-bit parallel-in-parallel-out shift register
74121 monostable multivibrator
74122 retriggerable monostable multivibrator with clear
74123 dual retriggerable monostable multivibrator with clear
74125 quadruple buffer (3-state)
74132 quadruple 2-input NAND Schmitt trigger
74141 BCD-to-decimal decoder/driver with high voltage outputs (max 60V, 7mA)
74148 priority encoder
74164 8-bit serial-in, parallel-out shift register
74174 hex D flip-flop with clear
74190 synchronous BCD up/down counter
74191 synchronous 4-bit binary up/down counter
74192 synchronous decase up/down counter
***74LS241** octal buffer and line driver (3-state)
***74LS242** quadruple bus tranceiver (3-state)
***74LS243** quadruple bus tranceiver (3-state)
***81LS95** octal buffer (3-state)
***81LS97** octal buffer (3-state)

*Low-power Schottky types only, not available in standard TTL.

TTL Logic ICs - functional index

gates, buffers, inverters

7400 quadruple 2-input NAND gate
7401 quadruple 2-input NAND gate with open-collector outputs
7402 quadruple 2-input NOR gate
7403 as 7400 but with open-collector outputs
7404 hex inverter
7406 as 7404 but with open-collector, high-voltage outputs (max 30V, fanout =25)
7408 quadruple 2-input AND gate
7409 as 7408 but with open-collector outputs
7410 triple 3-input NAND gate
7411 triple 3-input AND gate
7412 as 7410 but with open-collector outputs
7416 as 7404 but with open-collector, high-voltage outputs
7420 dual 4-input NAND gate
7428 as 7402 but power driver (fanout = 30)
7430 8-input NAND gate
7437 as 7400 but power driver (fanout = 30)
7440 as 7420 but power driver (fanout = 30)
7480 quadruple 2-input exclusive-OR gate

Schmitt triggers

7413 dual 4-input NAND Schmitt trigger
7414 hex inverting Schmitt trigger
74132 quadruple 2-input NAND Schmitt trigger

flip-flops, latches

7470 AND-gated positive-edge triggered JK flip-flop with preset and clear
7472 AND-gated JK flip-flop with preset and clear
7473 dual JK flip-flop with clear
7474 dual D positive-edge triggered flip-flop with preset and clear
7475 4-bit bistable latch
7476 dual JK master-slave flip-flop with preset and clear
74174 hex D flip-flop with clear

counters

7490 decade counter
7492 divide-by-12 counter
7493 4-bit binary counter
74190 synchronous BCD up/down counter
74191 synchronous 4-bit binary up/down counter
74192 synchronous decade up/down counter

shift registers

7495 4-bit parallel-in parallel-out shift register
74164 8-bit serial-in parallel-out shift register

decoders, display drivers

7445 BCD-to-decimal decoder/driver
7447 BCD-to-7-segment decoder/driver
74141 BCD-to-decimal decoder/driver with high-voltage outputs

monostable multivibrators

74121 monostable multivibrator
74122 retriggerable monostable multivibrator with clear
74123 dual retriggerable monostable multivibrator with clear

3-state buffers

74125 quadruple buffer
***74LS241** octal buffer and line driver
***74LS242** quadruple bus transceiver
***74LS243** quadruple bus transceiver
***81LS95** octal buffer
***81LS97** octal buffer

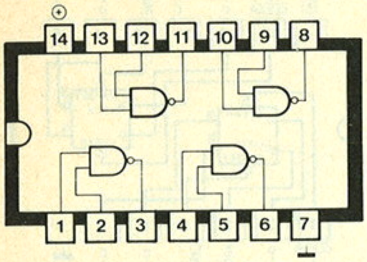
* Low-power Schottky types only, not available in standard TTL.

Miscellaneous

7485 4-bit comparator
7489 64-bit read-write memory
74148 priority encoder

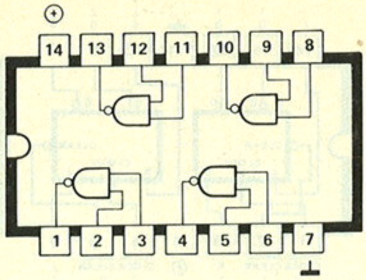
QUADRUPLE 2 INPUT NAND GATES

7400
7403 open collector outputs
7437 power driver (fan out = 30)



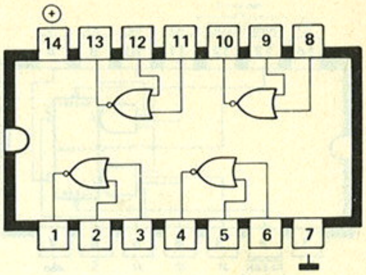
QUADRUPLE 2 INPUT NAND GATE WITH OPEN COLLECTOR OUTPUT

7401



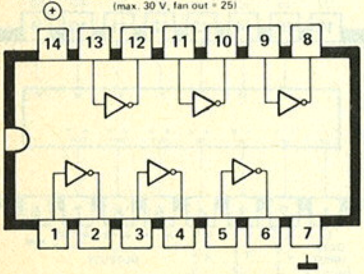
QUADRUPLE 2 INPUT NOR GATES

7402
7428 power driver (fan out = 30)



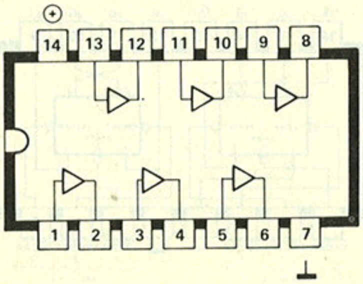
HEX INVERTERS

7404
7405 open collector outputs
7406 open collector high voltage outputs (max. 30 V, fan out = 25)
7416 open collector high voltage outputs (max. 30 V, fan out = 25)



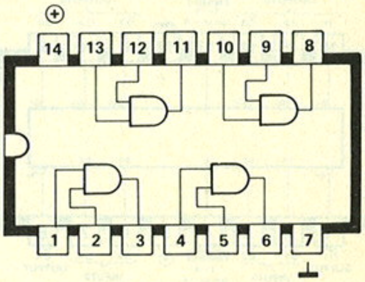
HEX BUFFER/DRIVER WITH OPEN COLLECTOR HIGH VOLTAGE OUTPUTS (max. 30 V, fan out = 25)

7407



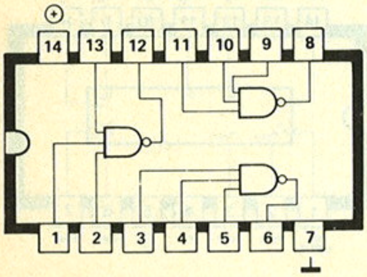
QUADRUPLE 2 INPUT AND GATES

7408
7409 open collector outputs



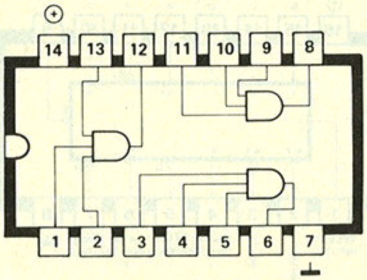
TRIPLE 3 INPUT NAND GATES

7410
7412 open collector outputs



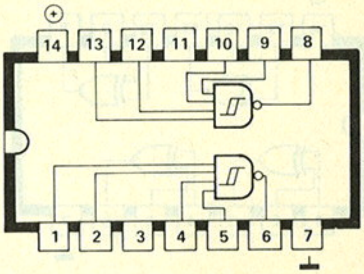
TRIPLE 3 INPUT AND GATE

7411



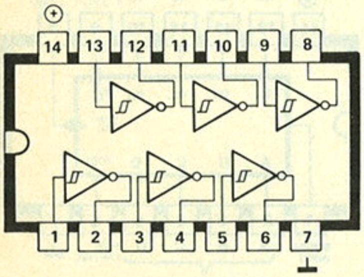
DUAL 4 INPUT NAND SCHMITT TRIGGER

7413



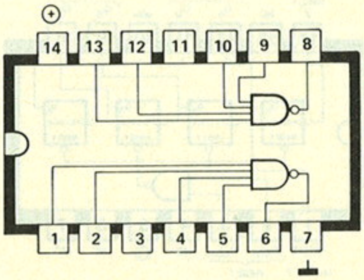
HEX SCHMITT TRIGGER INVERTER

7414



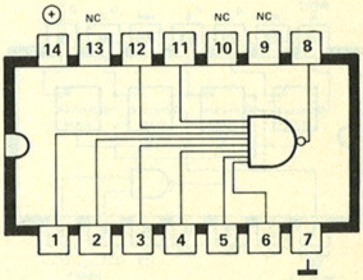
DUAL 4 INPUT NAND GATES

7420
7440 power driver (fan out = 30)



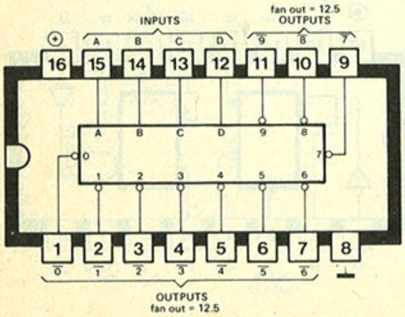
8 INPUT NAND GATE

7430



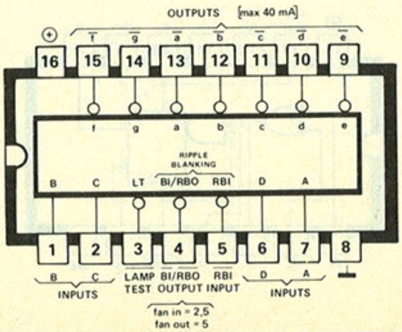
BCD-TO-DECIMAL DECODER/DRIVER WITH OPEN COLLECTOR OUTPUTS (max. 30 V)

7445



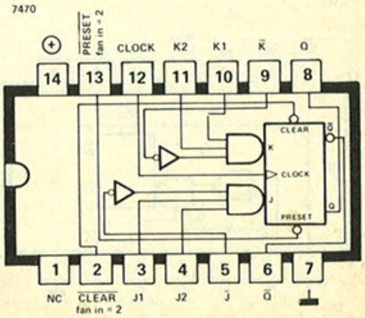
BCD TO 7 SEGMENT DECODER/DRIVER

7447



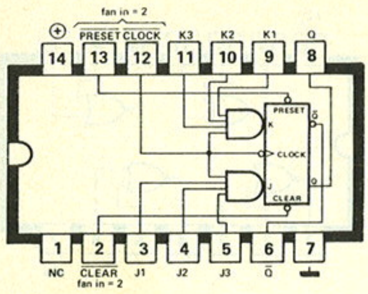
AND GATED J-K POSITIVE EDGE-TRIGGERED FLIP-FLOP WITH PRESET AND CLEAR

7470



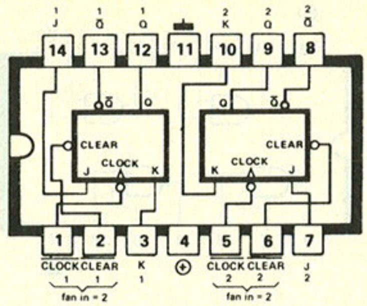
AND GATED J-K FLIP-FLOP WITH PRESET AND CLEAR

7472



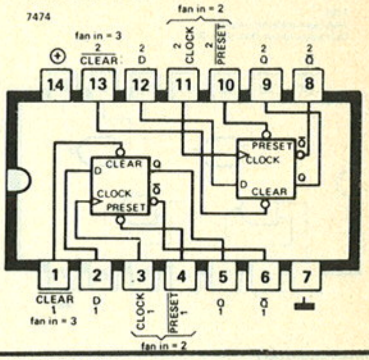
DUAL J-K FLIP-FLOP WITH CLEAR

7473



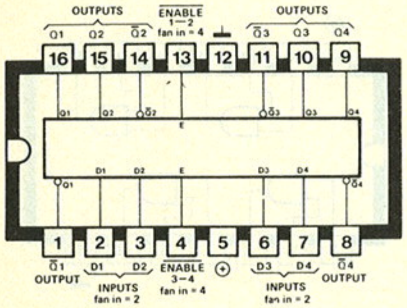
DUAL D-TYPE POSITIVE-EDGE-TRIGGERED FLIP-FLOP WITH PRESET AND CLEAR

7474



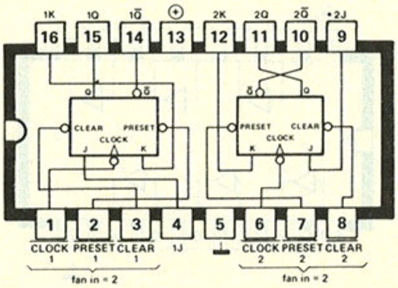
4-BIT BISTABLE LATCH

7475



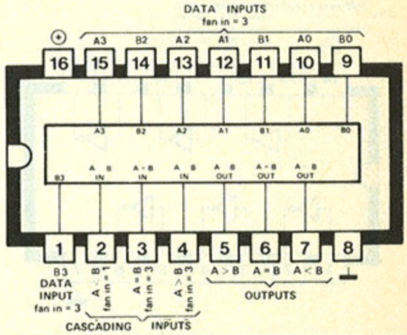
DUAL J-K MASTER-SLAVE FLIP-FLOP WITH PRESET AND CLEAR

7476



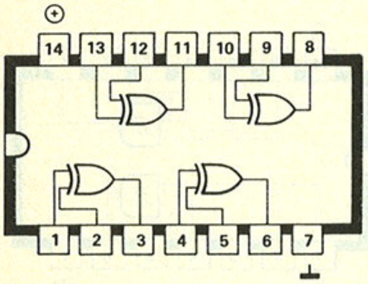
4-BIT COMPARATOR

7485



QUADRUPLE 2-INPUT EXCLUSIVE OR GATE

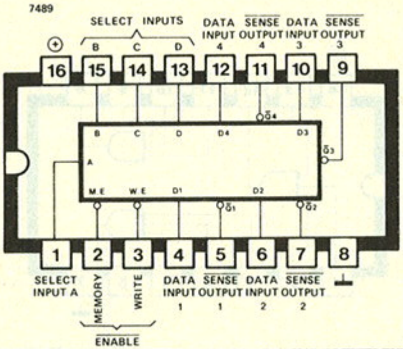
7486



64-BIT READ/WRITE MEMORY

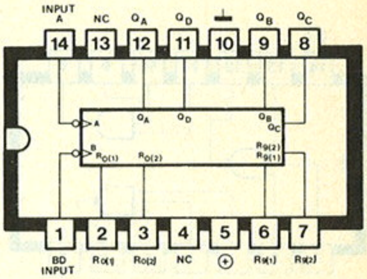
(fan out = 7.5)

7489



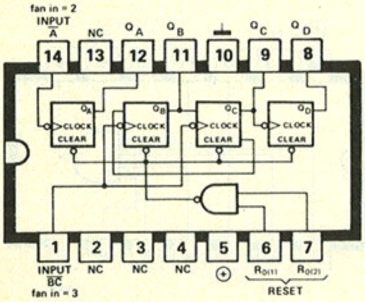
DECADE COUNTER

7490



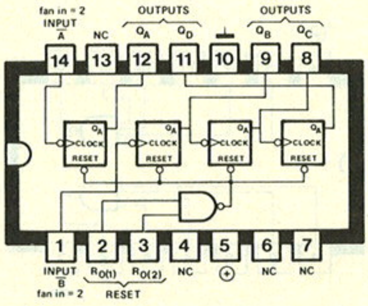
DIVIDE-BY-TWELVE COUNTER (÷ 2 and ÷ 6)

7492



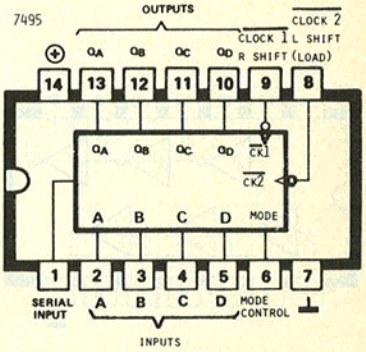
4-BIT BINARY COUNTER

7493



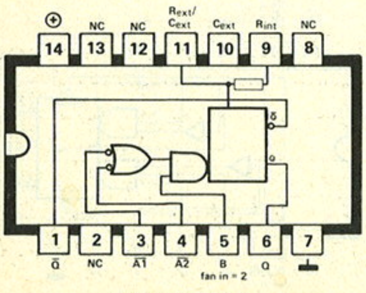
4-BIT PARALLEL-IN PARALLEL-OUT SHIFT REGISTER

7495



MONOSTABLE MULTIVIBRATOR

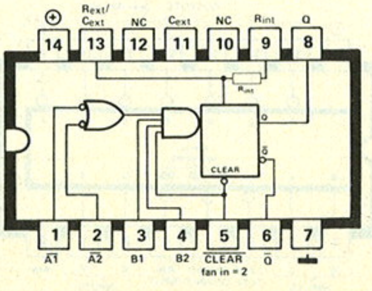
74121



'121 . . . Rint = 2 kΩ NOM.
'L121 . . . Rint = 4 kΩ NOM.

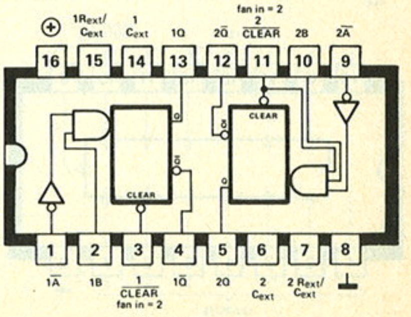
RETRIGGERABLE MONOSTABLE MULTIVIBRATOR WITH CLEAR

74122



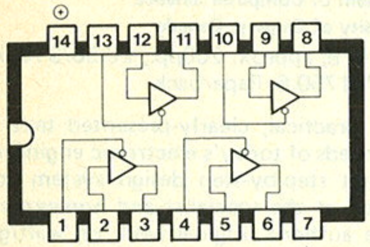
DUAL RETRIGGERABLE MONOSTABLE MULTIVIBRATOR WITH CLEAR

74123



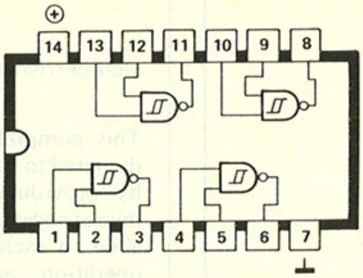
QUAD BUFFER (3 STATE)

74125



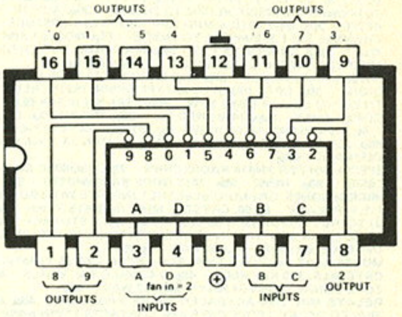
QUADRUPLE 2 INPUT NAND SCHMITT TRIGGER

74132



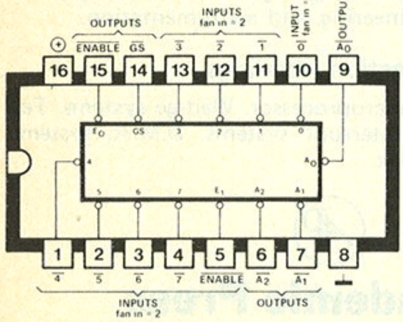
BCD TO DECIMAL DECODER/DRIVER
(outputs max. 60 V, max. 7 mA)

74141



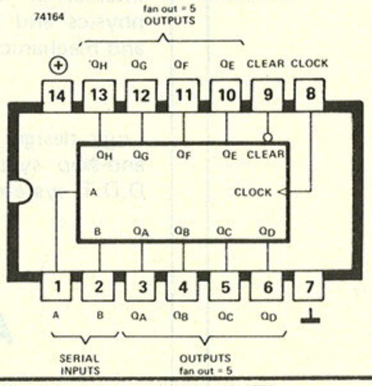
PRIORITY ENCODER

74148



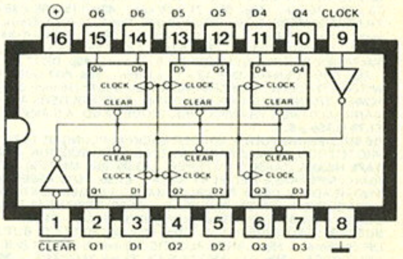
8 BIT SERIAL - IN PARALLEL OUT SHIFT REGISTER

74164



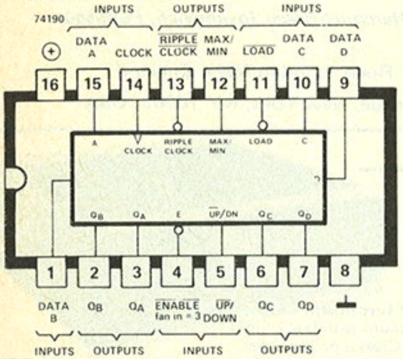
HEX D FLIP FLOP WITH CLEAR

74174



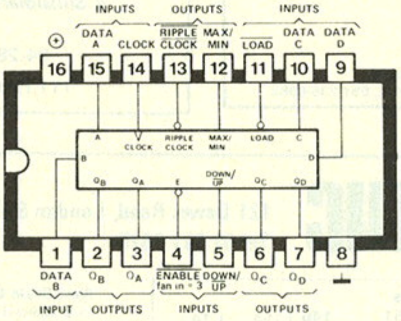
SYNCHRONOUS BCD UP/DOWN COUNTER WITH UP/DOWN MODE CONTROL

74190


INPUTS
OUTPUTS
INPUTS
⊕ DATA A CLOCK RIPPLE CLOCK MAX/MIN LOAD DATA C DATA D
16 15 14 13 12 11 10 9
A CLOCK RIPPLE CLOCK MAX/MIN LOAD C
QB QA E UP/DN QC QD
1 2 3 4 5 6 7 8
DATA B QB QA ENABLE fan in = 3 UP/DOWN QC QD
INPUTS OUTPUTS INPUTS OUTPUTS

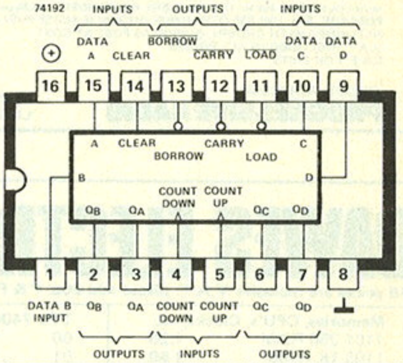
SYNCHRONOUS 4 BIT BINARY UP/DOWN COUNTER

74191


INPUTS
OUTPUTS
INPUTS
⊕ DATA A CLOCK RIPPLE CLOCK MAX/MIN LOAD DATA C DATA D
16 15 14 13 12 11 10 9
A CLOCK RIPPLE CLOCK MAX/MIN LOAD C
B D
QB QA E DOWN/UP QC QD
1 2 3 4 5 6 7 8
DATA B QB QA ENABLE fan in = 3 DOWN/UP QC QD
INPUT OUTPUTS INPUTS OUTPUTS

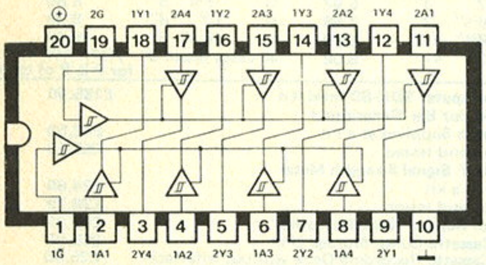
SYNCHRONOUS UP/DOWN DECADE COUNTER

74192



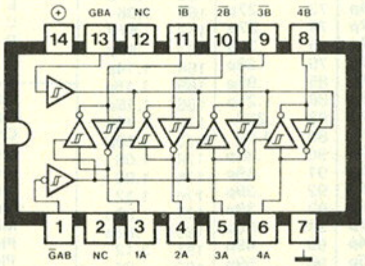
OCTAL BUFFER AND LINE DRIVER (3 STATE)

74LS241


⊕ 2G 1Y1 2A4 1Y2 2A3 1Y3 2A2 1Y4 2A1
20 19 18 17 16 15 14 13 12 11
1 2 3 4 5 6 7 8 9 10
1G 1A1 2Y4 1A2 2Y3 1A3 2Y2 1A4 2Y1

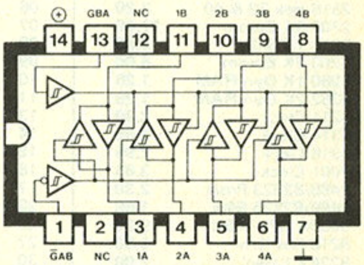
QUADRUPLE BUS TRANSCEIVER (3 STATE)

74LS242



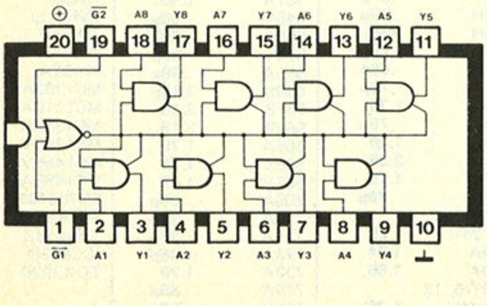
QUADRUPLE BUS TRANSCEIVER (3 STATE)

74LS243



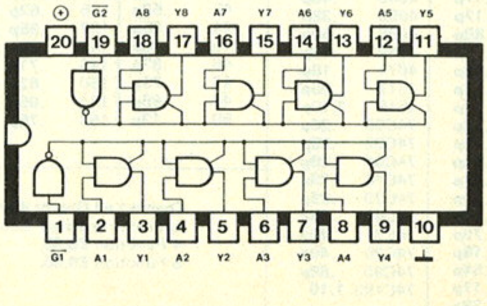
OCTAL BUFFER (3 STATE)

81LS95



OCTAL BUFFER (3 STATE)

81LS97



PROGRESSIVE RADIO

SEMICONDUCTOR OFFERS ALL FULL SPEC.
BC212, BC182, BC237, BF197, BC159, BCY71 – **ALL 8p each.** RCA 2015 T03 POWER TRANSISTOR (SIM TO 2N3055) – **35p.** ACY 18 – **18p.** BF200 – **20p.** MOTOROLA MRD 3051 PHOTOTRANSISTORS – **35p.** N CHANNEL F.E.T.S. SIMILAR TO 2N3819 – **17p.** MOSFET SIM TO 40673 – **35p.** 3N140 MOSFETS – **50p.** M203 DUAL MATCHED PAIRS MOSFETS, SINGLE GATE PER F.E.T. – **40p.** INTEL C1103 BIT MOS RAMS – **95p.** MULLARD BB113 TRIPLE VARICAP DIODE – **35p.** OPTO ISOLATORS TYPE BX504, INFRA-RED L.E.D. TO PHOTO CELL, 4 LEAD NEW – **25p.** TBA 800 10 FOR **£5.00.** CD4051 CMOS – **50p.** 7418 PIN D.I.L. – **23p.** 1N4002 100v 1A DIODES – **4p.** 1N4005 800v 1A DIODES – **7p.** 7812 12v 1A PLASTIC V. REGS – **95p.** 0.2" OR 0.125" RED LEDS – **12p each.** MAN 3A 3 mm LED DISPLAYS – **50p.**

SPECIAL OFFER ZN414 RADIO CHIPS – **75p.** LM380 IC AMPS – **80p.** LM381 – **90p.** NE555 – **30p** 741S (WIDE BANDWIDTH) – **35p.**

MICROPHONES. GRUNDIG ELECTRET INSERTS WITH BUILT-IN F.E.T. PREAMP – **£1.50.** CRYSTAL MIKE INSERTS 37 mm – **45p.** ELECTRET CONDENSER MIKES 1K IMP. WITH STD JACK PLUG – **£2.85.** EM104 MIN. TIE PIN CONDENSER MIKE, 1K IMP, OMNI, USES DEAF AID BATTERY (SUPPLIED) – **£4.95.**

MORSE KEYS. HI-SPEED TYPE ALL METAL – **£2.25** PLASTIC TYPE – **95p** 0.1"

CRYSTALS. 300 KHz HC6U – **40p.** 4.43MHz C.T.V. XTALS – **45p.** 0.1" EDGE CONNECTORS 64 WAY – **65p.** 32 WAY – **40p.**

RELAYS. MIN. 220v AC SEALED RELAY 2 POLE C/O – **45p.** 240v AC SEALED RELAY 3 POLE C/O 5 AMP CONTACTS 11 PIN BASE – **80p.** 12 VOLT 4 POLE N.O. REED RELAY – **20p.** 24 VOLT SEALED RELAY 2 POLE C/O 3 AMP CONTACTS – **55p.**

MOTORS. 1.5 TO 6v DC MODEL – **20p.** 115v AC MIN. 3 RPM WITH GEARBOX – **30p.** 240v AC SYNCH. MOTOR 1/5th RPM – **65p.** 240v AC SYNCH. MOTOR 1/24th RPM – **65p.** CROUZET 115v AC 4 RPM MOTORS – **95p.**

BOXES. BLACK A.B.S. PLASTIC WITH BRASS INSERTS AND LID. 75 x 56 x 35 mm – **40p.** 95 x 71 x 35 mm – **49p.** 115 x 95 x 36 mm – **57p.**

TRANSFORMERS. 6-0-6v 100mA, 9-0-9v 75mA, 12-0-12v 50mA – **75p. each.** 12-0-12v 100mA – **95p.** 12v 500mA – **95p.** 1:1 TRIAC/XENON PULSE TRANSFORMER – **30p.** 6 MHz 3 AMP CHOKES – **30p.**

SWITCHES. MIN TOGGLE SPST 8 x 5 x 7 mm – **45p.** DPDT 8 x 7 x 7 mm – **50p.** DPDT CENTRE OFF 12 x 11 x 9 mm – **75p.** POT CORE UNIT WITH 6 POT CORE, 1-FX2243 (45 mm), 2-FX2242 (35 mm) 3-T03 POWER TRANSISTORS ON HEAT SINK, FUSEHOLDERS AND VARIOUS OTHER TRANSISTORS, DIODES AND A 5 AMP S.C.R. – **£1.75 & 75p p & p.**

DE-SOLDERING TOOLS. SOLDER SUCKER, PLUNGER TYPE, EYE PROTECTION, REPLACEABLE NOZZLE, HIGH SUCTION – **£4.95.**

TAPE HEADS. CASSETTE STEREO – **£3.00.** BSR MN 1330 ½ TRACK DUAL IMPEDANCE REC/PLAY BACK – **£1.95.** TD10 ASSEMBLIES TWO HEADS ½ TRACK REC/PLAY BACK STAGGERED STEREO WITH BUILT-IN ERASE, PER HEAD – **£1.20.** TAPE HEAD DEMAG 240v AC – **£1.95.** EIGHT TRACK STEREO HEADS – **£1.75.**

BUZZERS. GPO TYPE 6–12v – **30p.** MIN. SOLID STATE BUZZERS 6–9–12 OR 24v/5mA – **75p.** LARGE PLASTIC (50 mm) DOMED 12v BUZZER, LOUD NOTE – **50p.** ALL METAL 6-12v 30 mm BUZZERS, – **25p.**

U.H.F. T.V. TRANSISTORISED PUSH BUTTON TUNERS (NOT VARICAP) NEW AND BOXED – **£2.50.**

8 WAY RIBBON CABLE, MIN-SOLID CORE, – **15p.** METRE. TIL305 ALPHA – NUMERICAL DISPLAYS, WITH DATA – **£2.75.**

AEROSOLS. SERVISOL SWITCH CLEANER + LUBRICANT 8oz – **55p.** FREEZER 6oz – **50p.** GEAR CLEANER & TAR REMOVER 14oz – **85p.**

MURATA MA401L 40KHz TRANSDUCERS, REC/SENDER – **£3.25 pair.**

POSTAGE, 30p. UNLESS OTHERWISE SHOWN (EXCESS POSTAGE REFUNDED WITH ORDER). OVERSEAS POST AT COST.
V.A.T. INCLUDED IN ALL PRICES.
S.A.E. FOR LISTS.

ORDER ADDRESS
PROGRESSIVE RADIO
31 CHEAPSIDE
LIVERPOOL 2. 051-236-0982

SYSTEM DESIGN WITH MICROPROCESSORS

D. Zissos

Department of Computer Science
University of Calgary, Canada

October/November 1978, approx. 200pp., £6.50/$13.50
0.12.781750.6, Paperback

This comprehensive, practical, clearly-presented text is designed to meet the needs of today's electronic engineers by providing the first step-by-step design system for microprocessors aimed at the specialist and non-expert alike. It includes the author's original work on wait/go operation, and establishes a 50-minute design cycle which even the amateur can master. It will be of great interest in the fields of telecommunications, medical physics and bioengineering, digital system design, civil and mechanical engineering, and instrumentation.

Section Headings

Logic design. The microprocessor. Wait-go systems. Test and-skip systems. Interrupt systems. D.M.A. systems. D.D.T. systems. Index.

Academic Press

London New York San Francisco

A Subsidiary of Harcourt Brace Jovanovich, Publishers

24-28 Oval Road, London NW1, England
111 Fifth Avenue, New York, NY 10003, USA

DAWES ELECTRONIC

121 Dawes Road, London SW6
Tel 01 381 3975

All prices are inclusive V.A.T. please add 20p. P & P.

New Style Elegant Instrument Cases
in a::odised aluminium with black vinyl top and bottoms. Gives a professional finish to your assemblies.

Type	Width	Height	Price	Type	Width	Height	Price
A	8¾"	3"	4.72	F	16½"	4½"	8.89
B	12"	3"	5.97	G	8¾"	6"	6.85
C	16½"	3"	7.68	H	12"	6"	8.38
D	8¾"	4½"	5.62	I	16½"	6"	10.42
E	12"	4½"	6.00				

all cases depth 9" **please add 80p for P & P of cases.**

Dawes computer SDK-80 Intel Kit	£185.00
Dawes Colour Bar Generator + Cross Hatch Supplied as a kit	£42.50
assembled and tested	£69.50
Dawes UHF Signal Strength Meter supplied as a kit	£24.60
assembled and tested	£29.75
Microfilm Reader "Caps Microfilm"	£95.00
Philips Cassette Comp Storage Unit	£65.00
Philips Cassette Recording Deck without Interface	£25.00

Memories, CPU's, Clocks, etc.

1101 256 RAM	1.25
1103 1K RAM	1.60
1702 2K Eprom	3.95
2102 1K Static	1.69
2107B4 4K Dyn	3.98
2513 64 x 8 x 5	4.70
2518 Hex 32 & 40	3.20
2708 8K Eprom	27.00
5013 1K Shift	2.60
5203 2K Eprom	8.00
5260 1K Dyn RAM	1.25
5262 2K Dyn RAM	1.25
5311 Clock	2.99
5314 Clock	2.95
5316 Clock	2.95
7001 Clock	3.85
7488/82S23 Prom	2.30
7489/82S25 64bi	1.89
8080A CPU 8 Bit	19.90
8216 Bus Driv	3.50
8224 C1 Gen'	7.00
8228 Sys Con	8.25
8255 Per Intfce.	12.50

TTL 7400 Series

00	.12p	51	.14p	154	1.14
01	.13p	53	.14p	155	.86p
02	.14p	54	.14p	156	.75p
03	.12p	60	.14p	157	.75p
04	.16p	70	.26p	158	.86p
05	.16p	72	.25p	160	.97p
06	.25p	73	.27p	161	1.06
07	.17p	74	.27p	162	.97p
08	.17p	75	.38p	163	.97p
09	.17p	76	.28p	164	1.14p
10	.14p	85	.95p	165	1.15p
11	.18p	86	.27p	166	1.15p
13	.27p	88	.230	170	1.79p
14	1.21	89	1.89	173	1.19p
15	.30p	90	.38p	174	1.08
16	.26p	91	.69p	175	1.08
17	.26p	92	.39p	176	1.12
20	.14p	93	.39p	177	.99p
23	.27p	94	.60p	180	.87p
27	.24p	95	.49p	181	3.12
30	.15p	96	.59p	182	.85p
32	.27p	100	.96p	190	1.02
37	.27p	107	.26p	191	1.02
38	.27p	109	.49p	192	1.02
40	.12p	121	.27p	193	1.02
41	.63p	122	.43p	194	.93p
42	.52p	123	.55p	195	.93p
43	.52p	125	.62p	197	1.00
44	.65p	132	.85p	198	1.50
45	.76p	141	.85p	199	2.30
46	.87p	145	.71p	200	4.30
47	.75p	150	.82p	279	.86p
48	.65p	151	.65p		
50	.13p	153	.75p		

4000 & 74C00 Series

4000	.17p	4042	.60p
4001	.17p	4049	.40p
4002	.17p	4050	.39p
4006	.80p	4066	.50p
4009	.39p	4069	.18p
4010	.39p	4071	.18p
4011	.17p	4512	.95p
4012	.17p	4518	1.10p
4013	.39p	74C00	.26p
4014	.99p	74C02	.26p
4015	.70p	74C04	.20p
4016	.41p	74C10	.29p
4017	.70p	74C20	.29p
4020	.80p	74C42	.90p
4022	.70p	74C74	.40p
4023	.18p	74C76	.40p
4024	.54p	74C90	.89p
4025	.17p	74C193	1.10
4027	.39p		
4030	.39p		

Digital Led Quartz Watch
with stainless steel armbands,
4 Function **£8.95,**
6 Function **£9.95.**

Lineare's (H,TO5, A-B, 14-16 dil. V. 8 dil T, TO220.K, TO3)

300H	.99p	370A	.87p	747A	.55p
301V	.37p	380AV	1.00	748V	.36p
302H	.59p	381A	1.50	75450	1.10
304H	69p	546V	.90p	75451 to 75454V	.25p
305H	.75p	550A	.68p	75491A	.82p
307V	.56p	555V	.38p	75492A	.82p
308V	.75p	556A	.99p	MC1303A	1.55
309K	1.30	560B	3.18p	MC1310A	1.65
310H	.75p	561B	3.18	MC1312A	1.80
311V	1.20	562B	3.18	MC1456V	1.20
312H	2.25	565A	1.75	MC1458V	.70p
318V	1.75	566V	1.75	MC1496A	.95p
319A	.88p	567V	1.75	SN76013N	1.50
320K-5, 12, 15, 24V	1.25	709A	.30p	SN76131A	.99p
324A	1.34	710A	.32p	TA7617A	1.35
339A	1.86	711A	.37p	ICL8038	3.00
340T-5, 12, 15, 24V	1.25	723A	.48p	TDA2020	3.25
		733A	1.75		
		739A	.89p		
		741V	.23p		

CMOS ICs – electrical characteristics

recommended supply voltage range:
3V 15V

logic levels:
output { 1 = + supply
output { 0 = 0V

input { 1 80% supply
input { 0 20% supply

input and output currents:

The DC input current of a CMOS gate is negligible due to the extremely high input resistance. The main load presented is due to the input capacitance of 3 to 7pF, which only has an effect during AC operation. The output current drive capacility of a CMOS gate is only a few hundred microamps. This is not a problem when interfacing with other CMOS gates at low-switching speeds, since they present a virtually infinite DC resistance. For AC operation the limiting factor on drive capability is the input capacitance of the driven gates more gates means a lower switching speed. The switching speed of a CMOS gate is generally specified at a load capacitance of 50pF.

Unused inputs

Unused inputs of CMOS ICs must not be left floating but must be tied direct to ground or positive supply depending on whether a 0 or 1 is required at the input.

Interfacing with TTL

A CMOS gate will drive one low-power (Schottky) TTL input, except for buffers such as the 4049 and 4050 which will drive two standard TTL inputs. The supply voltage of the CMOS circuit must obviously be the same as that of the TTL circuit (+5V).

CMOS Logic ICs – numerical index of popular types

4000 dual 3-input NOR gate plus inverter
4001 quadruple 2-input NOR gate
4002 dual 4-input NOR gate
4011 quadruple 2-input NAND gate
4012 dual 4-input NAND gate
4013 dual D flip-flop
4015 dual 4-bit static shift register
4017 divide-by-10 synchronous counter
4018 synchronous presettable divide-by-'n' counter
4020 14-bit binary ripple counter
4023 triple 3-input NAND gate
4024 7-stage binary ripple counter
4025 triple 3-input NOR gate
4027 dual JK flip-flop
4028 BCD-to-decimal decoder
4029 synchronous presettable binary/decade up/down counter
4030 quadruple 2-input exclusive-OR gate
4035 4-bit parallel-in-parallel-out shift register
4040 12-bit binary ripple counter
4042 quad clocked 'D' latch
4046 micropower phase-locked loop
4047 monostable/astable multivibrator
4049 hex inverting buffer
4050 hex buffer
4051 8-channel analogue multiplexer demultiplexer
4054 liquid-crystal display driver
4056 BCD-to-7-segment decoder/driver
4060 14-bit binary ripple counter and oscillator
4066 quadruple bilateral switch
4068 8-input AND/NAND gate
4070 as 4030 but will drive 2 low-power TTL loads
4071 quadruple 2-input OR gate
4073 triple 3-input AND gate
4078 8-input OR/NOR gate
4081 quadruple 2-input AND gate
4093 quadruple 2-input NAND Schmitt trigger
4098 dual monostable multivibrator
40106 hex inverting Schmitt trigger
4511 BCD-to-7-segment latch/decoder/driver
4518 dual 4-bit synchronous BCD up-counter
4520 dual 4-bit synchronous binary up-counter
4528 see 4098

CMOS Logic ICs – functional index

gates, inverters, buffers

4000 dual 3-input NOR gate plus inverter
4001 quadruple 2-input NOR gate
4002 dual 4-input NOR gate
4011 quadruple 2-input NAND gate
4012 dual 4 input NAND gate
4023 triple 3-input NAND gate
4025 triple 3-input NOR gate
4030 quadruple 2-input exclusive OR gate
4049 hex inverting buffer
4050 hex buffer
4068 8-input AND/NAND gate
4070 as 4030 but will drive 2 low-power TTL loads
4071 quadruple 2-input OR gate
4073 triple 3-input AND gate
4078 8-input OR/NOR gate
4081 quadruple 2-input AND gate

Schmitt triggers

4093 quadruple 2-input NAND Schmitt trigger
40106 hex inverting Schmitt trigger

flip-flops, latches

4013 dual D flip-flop
4027 dual JK flip-flop
4042 quad clocked 'D' latch

counters

4017 divide-by-10 synchronous counter
4018 synchronous presettable divide-by-'n' counter
4020 14-bit binary ripple counter
4024 7-stage binary ripple counter
4029 synchronous presettable binary/decade up/down counter
4040 12-bit binary ripple counter
4060 14-bit binary ripple counter and oscillator
4518 dual 4-bit synchronous BCD up-counter
4520 dual 4-bit synchronous binary up-counter

shift registers

4015 dual 4-bit static shift register
4035 4-bit parallel-in-parallel-out shift register

decoders/display drivers

4028 BCD-to-decimal decoder
4054 liquid crystal display driver
4056 BCD-to-7-segment decoder/driver
4511 BCD-to-7-segment latch/decoder/driver

monostable multivibrators

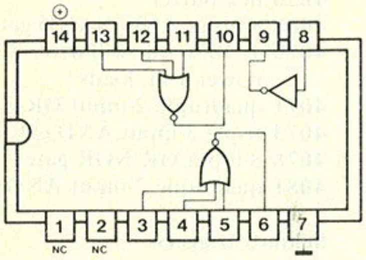
4047 monostable/astable multivibrator
4098 dual monostable multivibrator
4528 see 4098

miscellaneous

4046 micropower PLL
4051 8-channel analogue multiplexer/demultiplexer
4066 quadruple bilateral switch.

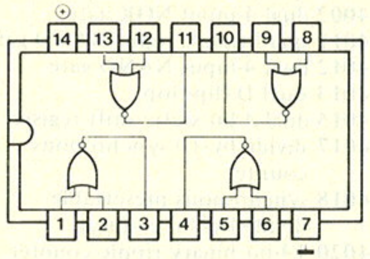
DUAL 3 INPUT NOR GATE PLUS INVERTER

4000



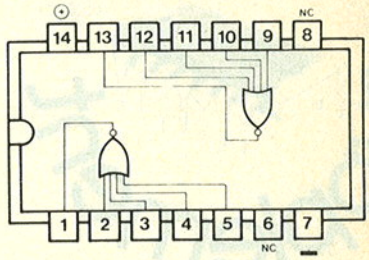
QUADRUPLE 2 INPUT NOR GATE

4001



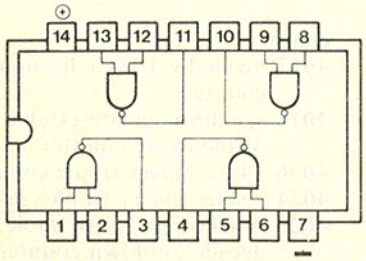
DUAL 4 INPUT NOR GATE

4002



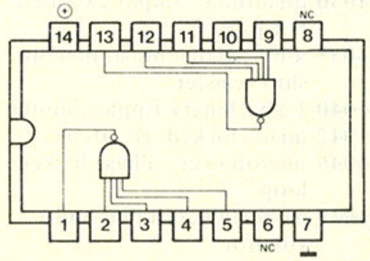
QUADRUPLE 2 INPUT NAND GATE

4011



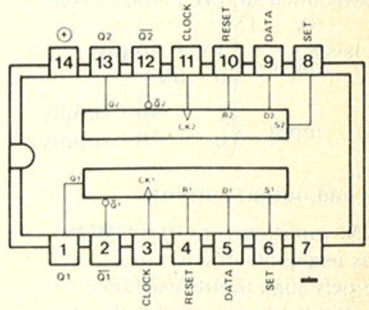
DUAL 4 INPUT NAND GATE

4012



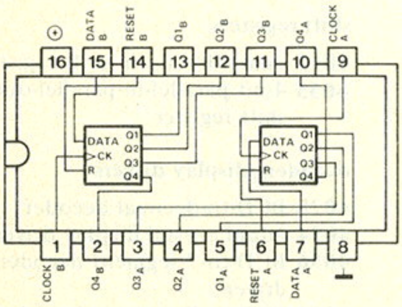
DUAL D FLIP FLOP

4013



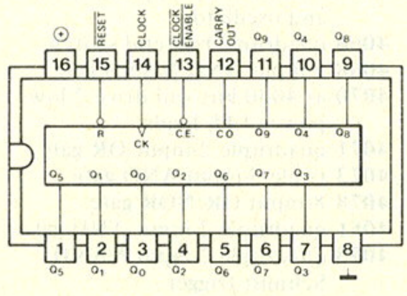
DUAL 4 BIT STATIC SHIFT REGISTER

4015



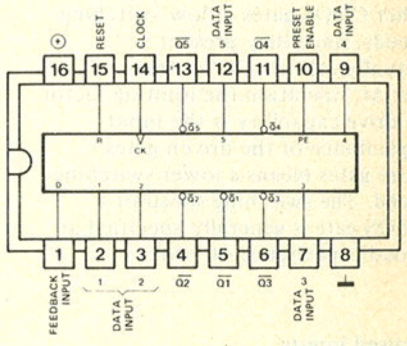
DIVIDE BY 10 SYNCHRONOUS COUNTER

4017



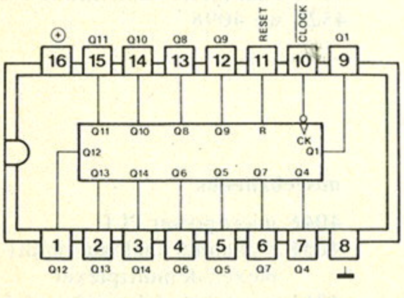
SYNCHRONOUS PRESETTABLE DIVIDE BY 'N' COUNTER

4018



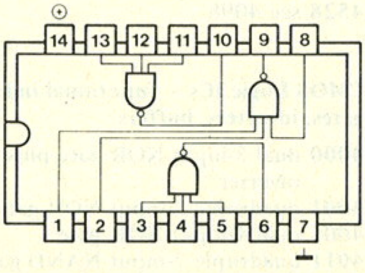
14 BIT BINARY RIPPLE COUNTER

4020



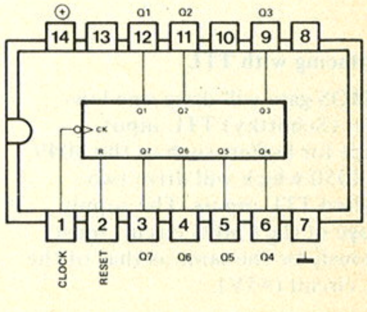
TRIPLE 3 INPUT NAND GATE

4023



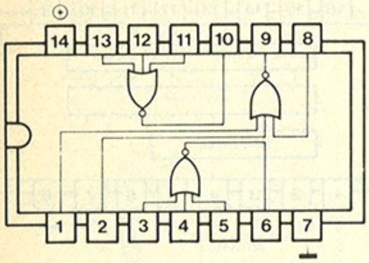
7 STAGE BINARY RIPPLE COUNTER

4024



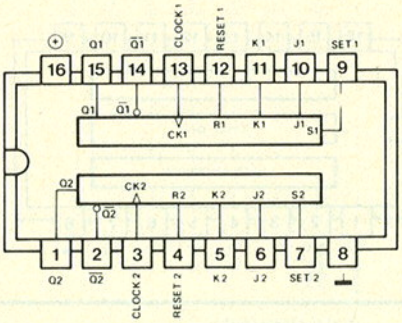
TRIPLE 3 INPUT NOR GATE

4025



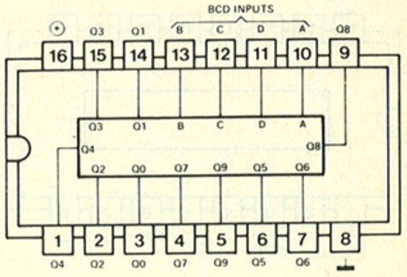
DUAL JK FLIP FLOP

4027



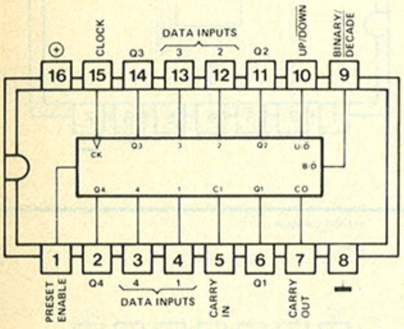
BCD TO DECIMAL DECODER

4028



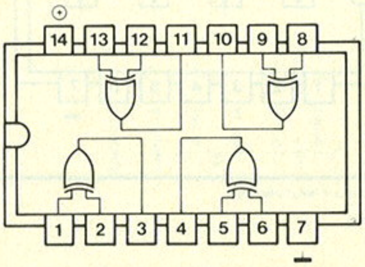
SYNCHRONOUS PRESETTABLE BINARY/DECADE UP/DOWN COUNTER

4029



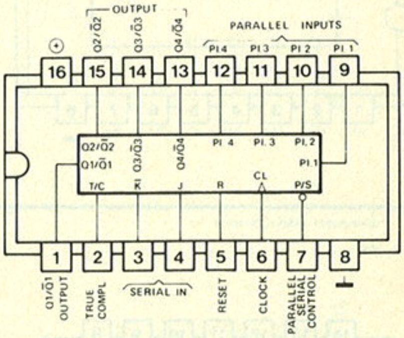
QUADRUPLE 2 INPUT EXCLUSIVE OR GATES

4030
4070 low power TTL compatible (fan out 2)



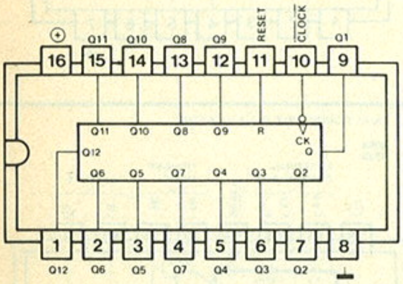
4 BIT
PARALLEL IN/PARALLEL OUT
SHIFT REGISTER

4035



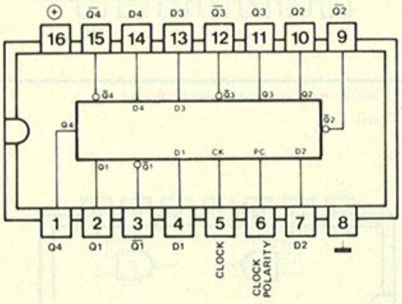
12 BIT BINARY RIPPLE COUNTER

4040



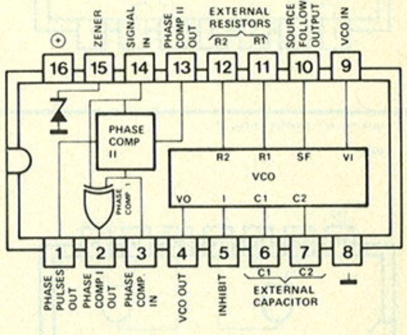
QUAD CLOCKED "D" LATCH

4042



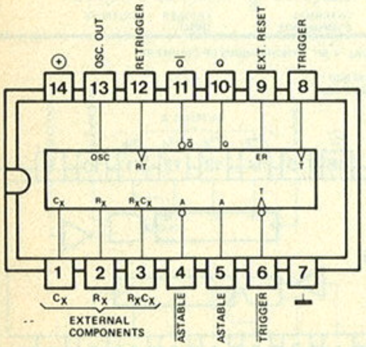
MICROPOWER PLL

4046



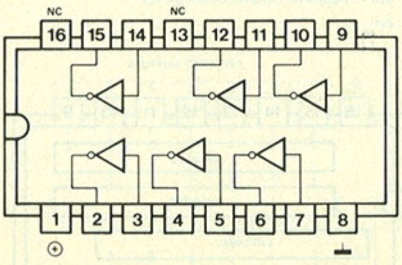
MONOSTABLE/ASTABLE MULTIVIBRATOR

4047



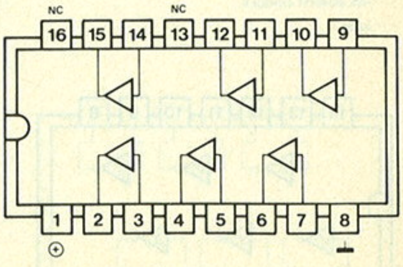
HEX INVERTING BUFFER

4049



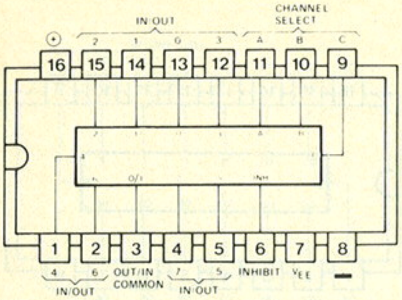
HEX BUFFER

4050



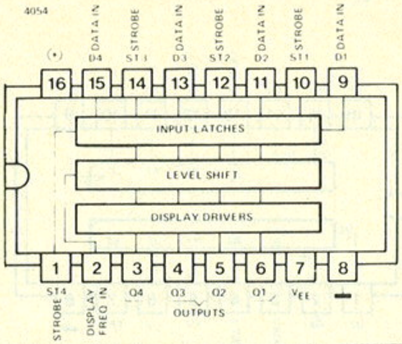
8 CHANNEL ANALOGUE MULTIPLEXER/DEMULTIPLEXER

4051



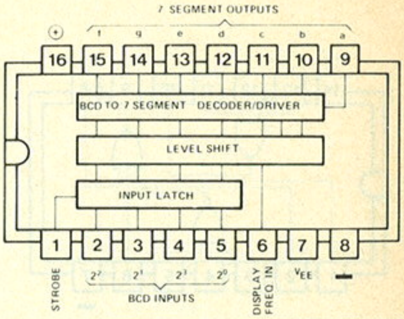
LCD DRIVER

4054



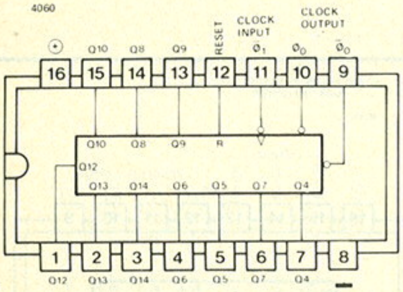
BCD TO 7 SEGMENT DECODER/DRIVER

4056



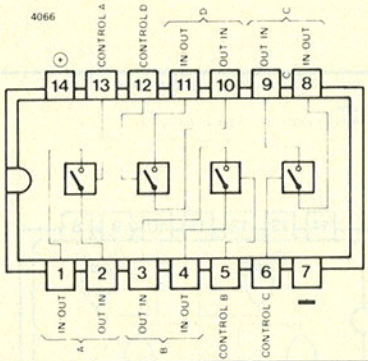
14 BIT BINARY RIPPLE COUNTER AND OSCILLATOR

4060



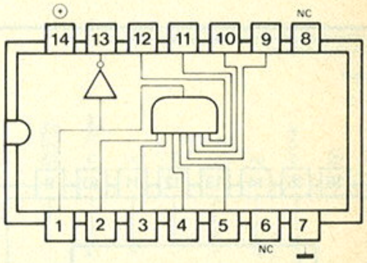
QUAD BILATERAL SWITCH

4066



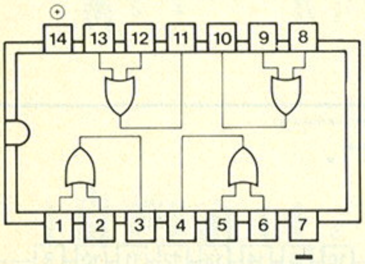
8 INPUT AND/NAND GATE

4068



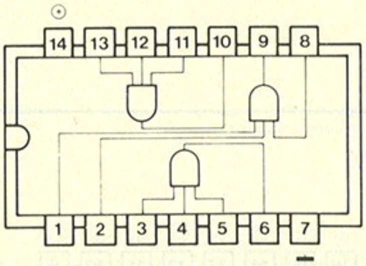
QUADRUPLE 2 INPUT OR GATE

4071



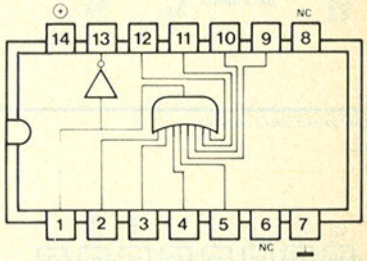
TRIPLE 3 INPUT AND GATE

4073



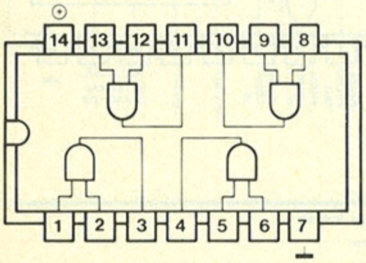
8 INPUT OR/NOR GATE

4078



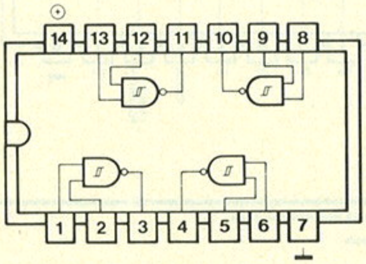
QUADRUPLE 2 INPUT AND GATE

4081



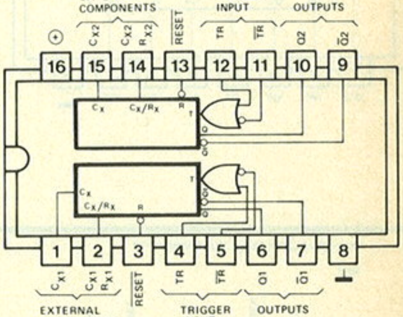
QUADRUPLE 2 INPUT NAND SCHMITT TRIGGER

4093



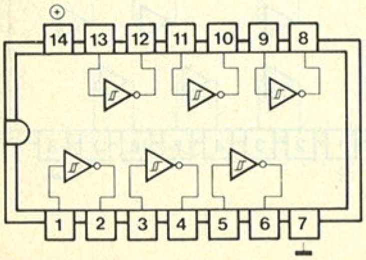
DUAL MONOSTABLE MULTIVIBRATOR

4098
4528



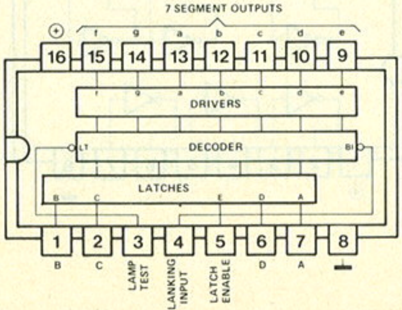
HEX SCHMITT TRIGGER

40106



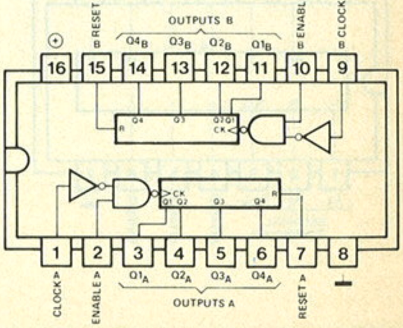
BCD TO 7 SEGMENT LATCH/DECODER/DRIVER

4511



DUAL 4-BIT SYNCHRONOUS UP COUNTERS

4518 BCD
4520 binary

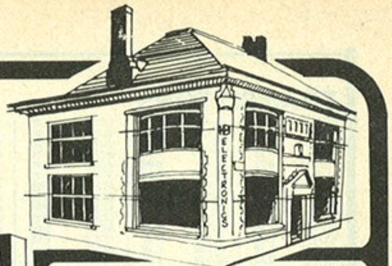


HB ELECTRONICS
In touch with tommorows technology.

22 Newland Street Kettering Northants.
Technical enquires ring Kett 520910 sales & order enquires 83922.
Shop open Monday to Saturday 9.30 to 6.00 p.m. Early closing Thursday.
Answer phone order service after 6.00 p.m. 83922

Back issues of Elektor & Elektor Boards normaly available from stock.
Quantity and trade enquiries welcomed for all components.

Quantity and trade enquires welcomed for all components.



IC's

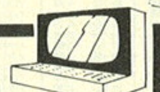
PRICE REDUCTIONS

CA3080	OTA	TO5	95
CA3084			300
CA3086	transistor array	14 dil	75
CA3090AQ	decoder	14 dil	575
CA3130T	opamp	TO5	120
CA3140T	FET opamp	TO5	120
ICM7038A	clock time base	8 dil	495
L129	5 V regulator	TO220	125
L130	12 V regulator	TO220	125
L131	15 V regulator	TO220	125
LF356	Bi Fet opamp	TO5	150
LD110CJ	digital DVM processor	16 dil	825
LD111CJ	analoque DVM		960
LM301AN	opamp	8 dil	70
LM308N	opamp	8 dil	130
LM311H	voltage comparator	TO5	150
LM317K	adjust reg.	TO3	400
LM311H	voltage comparator	TO5	255
LM318N	opamp	14 dil	310
LM324N	quad opamp	14 dil	98
LM325H	15 V regulator	TO5	360
LM326H	12 V regulator	TO5	360
LM327H	+ 5 – 12 V regulator	TO5	360
LM380N	audio amp	14 dil	140*
LM381N	dual audio pre amp	14 dil	220*
LM391	high power audio amp	16 dil	180*
LM555N	timer	8 dil	35
LM556N	dual timer	14 dil	86
LM556CN	vco	14 dil	170
LM567N	Pll tone decoder	8 dil	270
LM703LH	rf amp	TO5	100
LM709CN	opamp	8 dil	50
LM723CH	voltage regulator	TO5	75
LM723CN	voltage reg.	14 dil	85
LM741CN	opamp	8 dil	30
LM78L05	Voltage Reg	T092	38
LM78L05	Voltage Reg	T0220	95
LM78L012	Voltage Reg	T092	38
LM78L012	Voltage Reg	T0220	95
LM78L015	Voltage Reg	T092	38
LM78L015	Voltage Reg	T0220	95
LM1812N	ultra sonic transceiver	14 dil	720
LM1889	VHF Mod	18 dil	560
LM3900N	quad norton amp	14 dil	75
LM3909N	led flasher	8 dil	90
LM3911H	temp. transducer	TO5	180
M252	rhythm generator	16 dil	1175*
MC1310P	decoder	14 dil	220*
MC1312P	matrix SQ	14 dil	250*
MC1314P	vca SQ	16 dil	400*
MC1315P	logic control SQ	16 dil	600*
MC1458CP1	dual opamp	14 dil	90
MC1468L	dual regulator	14 dil	420
MC14440L	watch	40 dil	1393
MC1440Z	watch	flat pack	1600
MC14543CP	LCD driver	16 dil	147
MC14553P	3 digit counter	16 dil	396
MC14566P	time base	16 dil	132
MM2112	1K ram	16 dil	295
MM5204Q	EPROM	16 dil	POA
MM5314N	clock MPX 7 seg	24 dil	450
MM5316N	clokc non MPZ 7 seg	40 dil	550
MM5318N	clock BCD + address		740
MM5817	Noise generator		450
MM5841N	TV display driver	28 dil	1350*
RG4194TC	dual regulator	TO66	895
RC4151DN	V to F convertor	8 dil	750
SBV566	hall switch		120
SCMP1	ISP8A500D	40 dil	1250
SCMP2	ISP8A600N	40 dil	1000
SL440	Triac phase control	14 dil	450
SN76013N	audio	16 dil	180*
SN76131N	audio	14 dil	195*
SO41P	mixer	14 dil	195
SO42P	mixer	14 dil	195
STK025	Audio power IC		725*
STK032	Audio power IC		920
TAA550A	regulator	TO18	55
TAA861	opamp	TO5	155
TBA120	mixer	14 dil	95
TBA120T	IF	14 dil	95
TBA231	dual audio pre amp	14 dil	200*
TBA625A	5 V 100 mA regulator	TO5	110
TBA625B	12 V 100 mA regulator	TO5	110
TBA625C	15 V 100 mA regulator	TO5	110
TBA800SW	audio amp	16 quil	205*
TBA810S	audio amp		270*
TCA220	Triple opamp	16 dil	450
TCA280A			235
TCA740	DC tone	16 dil	530*
TDA1022	analogue shift register	16 dil	935
TDA1024	Triac Control 8 pin DIL		1.40
TDA2002	5 W 12 V audio amp		475
TDA2020	20W audio amp	14 quil	550*
U112B	triac control	14 dil	375
U113B	remote switch	4 dil	150
UAA170	led driver	16 dil	220
UAA180	led driver	18 dil	230
UA78G	regulator	TO220	235
UA79G	regulator	TO3	250
XR2206CP	function generator	16 dil	890
XR2207CP	VCO	14 dil	490
XR4212	Quad op amp	14 dil	250

LOW COST CMOS

4000	.16	4044	.93	4440	13.93
4001	.16	4046	1.23	4450	3.22
4002	.16	4049	.39	4450	3.22
4006	1.00	4050	.39	4490	7.83
4007	.16	4051	.39	4501	.16
4008	.91	4052	.85	4502	.81
4011	.16	4053	.85	4503	.67
4012	.16	4066	.85	4507	.34
4013	.39	4068	.57	4508	2.27
4014	.94	4069	.16	4510	1.14
4015	.94	4070	.16	4511	1.42
4016	.93	4071	.16	4512	1.05
4017	.94	4072	.16	4516	1.14
4018	.94	4073	.16	4517	3.37
4020	1.04	4075	.16	4521	1.78
4021	.94	4076	1.21	4522	1.31
4022	.85	4077	.16	4526	1.11
4023	.16	4078	.16	4527	1.49
4024	.69	4081	.16	4528	.98
4025	.16	4082	.16	4529	:.08
4027	.46	4093	.57	4530	.64
4028	.84	4160	1.08	4536	3.30
4032	.94	4161	1.08	4541	1.27
4035	1.02	4162	1.08	4543	1.47
4038	.99	4163	1.08	4553	3.96
4040	1.03	4174	.98	4557	3.81
4042	.69	4175	.90	4566	1.32
4043	.93	4194	1.07	4583	.70
				4584	.56

EXPERIMENTING WITH SC/MP



BUILD YOUR OWN MICROPROCESSOR DEVELOPMENT SYSTEM

The current Elektor series leads to the construction of a hexadecimal seven segment microcomputer with a cassette interface. Further development is planned, to produce a private computor system with visual display unit, cassette based programmes and an extended memory capacity.

To enable you to reduce your costs we are preparing a kit order list for each part of the series to enable you to order just those parts you need and not to duplicate components you already have.

Please send SAE for lists or phone Kettering 520910 for further details about the series.

HB Announce new lower prices on many products and a wide range of money saving bulk offers. Send SAE for full list. All components FULL SPEC.

BC107/8/9	85p/10
BC547/8/9	75p/10
BC557/8/9	75p/10
BC516/517	2.80/10
BC212/3/4	75p/10
IN4001/2/3	48p/10
1N4004/5	55p/10
1N4007	70p/10
1N4148	2.20/100
Red LED 0.2	95p/10
Red LED .125	95p/10
Yellow/Green 0.2	1.20/10
Yellow/Green .125	1.00/10
DL707	3.50/4
LM741 op amp 8 pin DIL	1.80/10
LM555 timer	2.60/10
LM324	7.00/10
8 pin DIL socket	1.00/10
14 pin DIL socket	1.10/10
16 pin DIL socket	1.20/10

74 SERIES TTL

PRICE REDUCTIONS

7400	12	7416	28	7439	30	7472	26	7493	44	74128	62	74156	70	74177	85
7401	12	7417	28	7440	18	7473	30	7494	80	74132	60	74157	70	74180	85
7402	14	7420	15	7441	52	7474	28	7495	60	74136	75	74160	90	74181	220
7403	14	7421	40	7442	62	7475	45	7496	65	74137	80	74161	90	74182	80
7404	14	7422	20	7443	120	7476	32	74100	120	74141	70	74162	90	74185	150
7405	14	7423	25	7444	120	7480	48	74104	52	74142	290	74163	90	74189	320
7406	30	7424	30	7445	75	7481	115	74105	52	74143	290	74164	100	74190	120
7407	32	7425	26	7446	120	7482	85	74107	35	74144	290	74165	100	74191	120
7408	18	7426	26	7447	65	7483	75	74109	48	74145	65	74166	100	74192	95
7409	18	7427	26	7448	65	7484	120	74110	50	74147	150	74167	325	74193	98
7410	15	7428	40	7450	15	7485	80	74118	90	74148	140	74170	160	74194	95
7411	24	7430	15	7451	15	7486	30	74121	38	74150	100	74172	600	74195	75
7412	26	7432	26	7453	15	7489	220	74122	65	74151	62	74173	130	74196	95
7413	30	7433	47	7454	15	7490	38	74123	58	74153	55	74174	90	74197	92
7414	70	7437	26	7460	15	7491	76	74125	46	74154	80	74175	72	74198	150
7415	34	7438	26	7470	30	7492	44	74126	46	74155	70	74176	85	74199	160

HARDWARE & EQUIPMENT

Edge connectors 64 way (SC/MP)	(pair)	7.00
Edge connectors 31 way (format)	(pair)	3.00
Edge connectors 31 way (test pattern gen)	(pair)	1.50

SWITCHES

ROTARY

1 pole 12 way	54
2 pole 6 way	54
3 pole 4 way	54
4 pole 3 way	54

SLIDE

2 pole 2 way	18

MINIATURE TOGGLE

1 pole 1 way	65
1 pole 2 way	65
2 pole 1 way	65
2 pole 2 way	75
2 pole 2 way c/off	75
2 pole 2 way biased	80
2 pole 2 way locking	80
2 pole 2 way c/off	130

MINIATURE PUSH

1 pole 1 way	non latching	15
1 pole 1 way	latching	55
1 pole 2 way	latching	60
2 pole 2 way	latching	90
4 pole 1 way	non latching	45

ANTEX SOLDERING IRONS

C2 15W light duty version	380
CX 15/18 18W ceramic shaft	380
X25 25W standard version	340
ST3 Soldering Irons Stand, complete with sponge	140
Spare bits for all above ANTEX Irons	48
Spare elements for C2	145
for CCN/R	190
For X25	160

TRANSISTOR SOCKET, TO18, TO5 — 10 each

SILVER PLATED COPPER WIRE

18 swg	60/mtr
22 swg	50/mtr
24 swg	45/mtr

DIL SOCKETS

8 pin	12
14 pin	14
16 pin	16
24 pin	45
40 pin	65

LOUDSPEAKERS

64 ohm 2.5 ins	75*
8 ohm 2.5 ins	60*

VEROBOARD 0.1 inch

2.5 x 3.75 inch	42
2.5 x 5 inch	50
3.75 x 5 inch	56
V-Q board 01-0044C	91

S	Dec	1.98
u	Dec A	3.99
T	Dec	3.64

CATALOGUE '78

Catalogue 78 available now.

A must for serious constructors. Contains details of many unusual and difficult to obtain components for Elektor projects plus pages and pages of data information pin outs etc.
Normal price 75p but as special introductory offer for Elektor readers for limited period 50p.
plus 18p P & P

50p

CAPACITORS

MKM METALLISED POLYCARBONATE

7.5 mm radial leads – direct fit for many EPS boards.
Tolerance: + 10% up to 8n2 + 5% 10n and above
max. wkg. voltage: 250 V DC up to 47n 100 V DC 56n and above.

		individual price
1000 pF	1n0	5*
1500 pF	1n5	5*
2200 pF	2n2	5*
3300 pF	3n3	5*
4700 pF	4n7	5*
6800 pF	6n8	5*
8200 pF	8n2	6*
0.01 uF	10n	6*
0.012 uF	12n	6*
0.015 uF	15n	6*
0.018 uF	18n	6*
0.022 uF	22n	6*
0.027 uF	27n	6*
0.033 uF	33n	6*
0.039 uF	39n	6*
0.047 uF	47n	7*
0.056 uF	56n	7*
0.068 uF	68n	7*
0.082 uF	82n	7*
0.1 uF	100n	7*
0.12 uF	120n	8*
o.15 uF	150n	8*
o.18 uF	180n	10*
0.22 uF	220n	10*
o.27 uF	270n	12*
0.33 uF	330n	14*
0.39 uF	390n	16*
0.47 uF	470n	16*
0.56 uF	560n	20*
0.68 uF	680n	20*
1.0 uF (100mm pitch)		25*

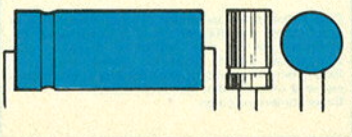
CERAMIC

Close tolerance high stability sub-miniature plate capacitors. 63 V dc. E6 series values.

1 pF to 8.2 pF	4*
10 pF to 82 pF	5*
100 pF to 820 pF	7*

ELECTROLYTIC CAPACITORS

uF	V 6.3	10	16	25	35	63
0.47;1.0;1.5						8*
2.2						8*
3.3					8*	9*
4.7				8*	9*	9*
10			8*	8*	9*	12*
15		8*	9*	9*	11*	15*
22	8*	8*	8*	9*	11*	15*
33	8*	9*	9*	11*	12*	16*
47	9*	9*	10*	12*	15*	22*
100	10*	12*	12*	16*	20*	36*
220	12*	14*	16*	21*	27*	50*
330	15*	17*	18*	24*	33*	70*
470	16*	19*	21*	31*	39*	90*
1000	21*	24*	33*	46*	72*	110*
2200	33*	40*	52*	79*	122*	150*
4700	42*	54*	97*	120*	150*	185*



CRYSTALS, FILTERS & INDUCTORS

32.768	kHz	KDT-3	3.20
32.768	kHz	MTQ 32-12	6.00
1.0	MHz	HC 33/U	4.50
2	MHz	HC 33/U	4.50
3.2768	MHz	HC 33/U	4.50
4.19304	MHz	HC 33/U	4.50
4.7	MHz	HC 33/U	4.50
6.364068	MHz	HC 33/U	4.50
10.25	MHz	HC 18/U	3.00
27	MHz	HC 25/U	2.15
39	MHz	HC 25/U	2.15

CERAMIC FILTERS

SFE 6.0 MA	60
SFE 10.7	70
CFT 455B	70
SFD 455B	70
CDA 10,7 MA	150
TV Crystal 4.433619 MHz	2.00

Fixed inducers for PC mounting values
E12 0.1 uH to 100 mH. Ring or write for details.

TRANSISTORS & DIODES

For full list send SAE or see our Catalogue 78

AF239	50	BD139	40*	TIP29A	35*
BA127	11	BD140	45*	TIP31A	40*
BB104	60*	BD240	70	TIP41A	60
BB105	37*	BD241A	70	TIP42A	70
BB106	55*	BD242	75	TIS43	35
BB109	49*	BF194	09*	IN4001	05
BC107	10	BF195	09*	1N4002	05
BC108	10	BF199	15	1N4003	06
BC109	10	BF200	30	1N4004	06
BC140	42	BF225	20	1N4005	07
BC160	35	BF244	30	1N4006	07
BC177	18	BF245	28	1N4007	07
BC182L	10*	BF245c	30	1N4148	05
BC184L	10*	BF254	18	2N2219	25
BC212L	10*	BF494	45	2N3054	50
BC214L	10*	BF495	45	2N3055	50
BC516	30	BFX29	25	2N3702	09
BC517	35	BFY50	19	2N3703	09
BC547	10*	BFY51	19	2N3704	09
BC547b	12*	BFY52	19	2N3705	09
BC548	10*	BFY90	85	2N3819	18
BC549	10*	BRY39	35	2N5777	65
BC549b	12*	BRY56	45	40603	80
BC549c	13*	BY127	10	Zener Diodes 1W	
BC557	12*	BY164	70	3.3v to	
BC557b	15*	BY187	1.35	Zener Diodes	
BC558	12*	E100	40	400mW 2.7v to 47v	
BC559	12*	E300	45	E12 Series	12*
BC559b	15*	E310	60	Bridge rectifiers	
BC559c	16*	E420	1.60	for Elektor projects	
BCY70	19	E430	1.45	B 40C800W	40
BCY71	20	MJE340	80	B 40C5000	60
BD131	45*	MJE341	65	B250C1000	70
BD132	45*	MJE2955	1.40	B250C22001	50
BD138	53*	MJE3055	1.20		

Visit our new computer showroom.
Where our sister company, HB computers will be demonstrating the PET 2001, now in stock.

MICROPROCESSORS & PERIFI

Micro's and Memories
Send SAE for lists of development kits etc.

1103A-2	5.25
CDP1802 MPU	16.50
MC1488 RS 232 Interface	1.40
MC1489 RS 232 Interface	1.40
MM1702A EPROM 256 x 8	4.98
MM2102AN RAM 1k x 1	1.50
MM2107B	4.50
MM2112 RAM 256 x 4	2.95
MM2708 EPROM 1k x 8	10.50
271AJ EPROM 2k x 8	21.00
MM5204 (Blank) EPROM 512 x 8	10.50
SC/MP 1SP8A 500D MPU	12.50
SC/MP 1SP 8A 600D MPU	10.50
COSMAC vid computer on a card with built in PSU sound effects gen ans TV interface. Complete with HEX keypad, monitor in ROM + 2048 byte of RAM	£230

OPTOELECTRONICS

PRICE REDUCTIONS

Display	drive	decimal point	size	mounting	digits	price
DL704	CC	RDP	0.3"	14 dil	single	1.20
DL707	CA	LDP	0.3"	14 dil	single	1.20
DL727	CA	RDP	0.5"	18 dil	dual	1.95
DL728	CC	RDP	0.5"	18 dil	dual	2.20
DL747	CA	LDP	0.63"	18 dil	single	2.20
DL750	CC	LDP	0.63"	18 dil	single	2.20
FND500					single	1.65
HP7730	CA	LDP	0.3"	14 dil	single	1.80
HP7732	CA	LDP	0.3"	14 dil	1	2.30
HP7750						1.80

BPW 34	photo diode	2.60
IL 74	opto isolator	1.10
IRL 60	infra red led	.70
LD 241	infra red transmitter	2.40
2N5777	photo darlington	.65
ORP 12	light dependent resistor	.80
Wire ended neon		.20
LED red o.2"		.15
LED red 0.125"		.12
LED green; yellow; clear 0.2"		.22
LED green, yellow; 0.125"		.22

ORDERING DETAILS

DISCOUNT. Mail order customers deduct 10% on orders over £20.00.
VAT add high rate to *items, standard rate to others
POST & PACKING 50 p on orders under £7.50. Otherwise free. Overseas please add freight costs and state surface or Air.
DELIVERY. All orders processed on day of receipt. All goods offered subject to availability and our conditions of sale.
PAYMENT. Cash, cheque or postal order with order. Access, Mastercharge, Bank Americard visa or Barclaycard number by phone or letter for orders over £2 Official orders from Government bodies, accepted, but minimum invoice charge £2.50.
GUARANTEE. All devices are brand new and full spec. unless otherwise stated. Any faulty item returned in good condition within fourteen days will be exchanged or refunded.
BACK copies of Elektor and Elektor EPS circuit boards available at published prices.

PRICES valid at the time of going to press

ENQUIRIES. Please enclose suitable s.a.e. **E & O E.**

TRANSISTORS

AC107	0.23	BC116A	0.12	BC258	0.20	BD235	0.50	OC75	0.10	2N2904A	0.15
AC125	0.19	BC117	0.11	BC261	0.09	BD238	0.50	OC81	0.12	2N2905	0.15
AC126	0.15	BC118	0.10	BC262	0.20	BD437	0.50	OC82	0.48	2N2905A	0.15
AC127	0.15	BC119	0.20	BC302	0.25	BDX77	0.90	TIP29A	0.40	2N2906	0.12
AC127K	0.23	BC147	0.06	BC303	0.25	BF153	0.08	TIP29B	0.45	2N2907A	0.12
AC128	0.12	BC148	0.06	BC307	0.25	BF178	0.20	TIP30	0.35	2N2926G	0.08
AC128K	0.25	BC149	0.06	BC308	0.25	BF179	0.20	TIP30A	0.40	2N29261	0.08
AC141	0.18	BC153	0.10	BC319C	0.25	BF180	0.15	TIP30B	0.45	2N3053	0.12
AC142	0.18	BC154	0.15	BC327	0.09	BF181	0.15	TIP31	0.35	2N3054	0.35
AC142/01	0.19	BC157	0.06	BC327/16	0.10	BF182	0.15	TIP31A	0.40	2N3055	0.35
AC151	0.19	BC158	0.06	BC328	0.09	BF183	0.15	TIP31B	0.45	2N3055	
AC153	0.13	BC159	0.06	BC337	0.09	BF184	0.15	TIP32	0.35	Motorola	0.50
AC153K	0.18	BC168	0.10	BC338	0.09	BF185	0.15	TIP32A	0.40	2N3133	0.20
AC176	0.12	BC169	0.06	BC347A	0.15	BF194	0.06	TIP32B	0.45	2N3442	1.00
AC176K	0.16	BC170	0.06	BC350A	0.17	BF195	0.06	TIP41	0.35	2N3553	0.50
AC187	0.16	BC171	0.06	BC441	0.20	BF196	0.06	TIP41A	0.40	2N3702	0.08
AC187K	0.18	BC172	0.06	BC461	0.24	BF197	0.06	TIP41B	0.45	2N3704	0.06
AC187/188	0.35	BC173	0.08	BC537	0.29	BF200	0.25	TIP42	0.35	2N3705	0.06
AC188	0.16	BC177	0.12	BC547	0.10	BF202	0.30	TIP42A	0.40	2N3711	0.06
AC188K	0.18	BC178	0.12	BC547A	0.11	BF203	0.30	TIP42B	0.45	2N3715	1.89
ACY17	0.72	BC179	0.12	BC547B	0.11	BF324	0.20	TIP2955	0.65	2N3819	0.18
ACY28	0.19	BC182L	0.09	BC547C	0.12	BF336	0.25	TIP3055	0.40	2N3903	0.10
AD143	0.70	BC183	0.09	BC548A	0.11	BFS28	1.00	TIS90	0.18	2N3904	0.08
AD149	0.50	BC183L	0.09	BC548B	0.11	BFW10	0.40	2N393	0.30	2N3905	0.08
AD161	0.35	BC183LA	0.09	BC548C	0.11	BFW11	0.40	2N404	0.29	2N3906	0.08
AD161/162	0.70	BC183LB	0.10	BC557	0.09	BFW30	1.00	2N456A	0.50	2N4058	0.10
AD162	0.35	BC184	0.08	BC557B	0.09	BFW57	0.15	2N696	0.10	2N4124	0.20
AF116	0.16	BC184L	0.09	BC557C	0.10	BFW58	0.15	2N697	0.10	2N5036	0.30
AF117	0.20	BC186	0.19	BC558	0.09	BFX12	0.20	2N706	0.07	2N5484	0.35
AF118	0.40	BC187	0.19	BC559	0.09	BFX29	0.20	2N706A	0.08		
AF124	0.25	BC204	0.08	BCX32	0.12	BFX30	0.20	2N708	0.08		
AF125	0.28	BC204B	0.09	BCX36	0.12	BFX84	0.27	2N918	0.36		
AF126	0.25	BC205	0.09	BCY31	0.80	BFX88	0.17	2N929	0.14		
AF127	0.25	BC205A	0.10	BCY40	0.50	BFX89	0.17	2N987	0.12		
AF139	0.19	BC206	0.10	BCY42	0.55	BFY50	0.12	2N1302	0.12		
AF178	0.29	BC206B	0.11	BCY58	0.20	BFY51	0.12	2N1303	0.15		
AF179	0.29	BC207	0.10	BCY70	0.13	BFY52	0.12	2N1304	0.15		
AF180	0.29	BC208	0.10	BCY71	0.13	BFY90	0.50	2N1307	0.20		
AF181	0.29	BC208B	0.11	BCY72	0.13	BR101	0.26	2N1308	0.20		
AF186	0.29	BC208C	0.12	BCZ11	0.28	BRY39	0.25	2N1309	0.20		
AF239	0.29	BC209	0.10	BD113	0.50	BRY56	0.25	2N1484	1.00		
ASY26	0.48	BC209B	0.11	BD115	0.30	BSV64	0.30	2N1507	0.15		
ASY27	0.29	BC212	0.10	BD123	0.60	BSV79	0.75	2N1613	0.15		
ASY29	0.62	BC212L	0.11	BD124	0.65	BSV80	0.75	2N1671	1.10		
ASY73	0.29	BC213	0.10	BD131	0.35	BSV81	0.85	2N1711	0.15		
ASZ17	0.59	BC213L	0.10	BD131/132	0.80	BSX21	0.14	2N2218	0.15		
AU107	1.00	BC214	0.10	BD132	0.35	BSY40	0.27	2N2219A	0.18		
AU113	0.90	BC214L	0.10	BD135	0.30	BSY95A	0.12	2N2221	0.15		
AU210	0.90	BC237	0.15	BD136	0.30	BT106	0.96	2N2222	0.15		
BC107	0.06	BC237A	0.16	BD137	0.30	BU105	1.50	2N2369	0.10		
BC107A	0.06	BC237B	0.18	BD137/138	0.70	BU126	0.80	2N2401	0.30		
BC107B	0.06	BC237C	0.21	BD138	0.30	BU204	1.50	2N2412	0.70		
BC108	0.06	BC238	0.15	BD139	0.30	BU205	1.60	2N2483	0.22		
BC108A	0.06	BC238B	0.16	BD140	0.30	BU207	1.80	2N2646	0.40		
BC108B	0.06	BC238C	0.18	BD142	0.30	OC22	1.40	2N2904	0.15		
BC109	0.06	BC239	0.21	BD201	0.80	OC29	0.85				
BC113	0.10	BC251	0.10	BD202	0.80	OC44	0.12				
BC114	0.10	BC251A	0.15	BD203	0.80	OC45	0.12				
BC115	0.10	BC252B	0.17	BD204	0.80	OC71	0.09				
BC116	0.11	BC252C	0.20	BD234	0.50	OC72	0.12				

DIODES

AA119	0.17	BB105G	0.35	BY201-3	0.40	ITT210	1.35	OA202	0.07
AA121	0.11	BB110G	0.45	BY201-4	0.45	ITT827	2.35	ST2	0.14
AA129	0.08	BB142	1.25	BY201-5	0.55	ITT921	0.20	1N4001	0.04
AA143	0.15	BR100	0.20	BY201-6	0.55	ITT923	0.35	1N4002	0.05
AA144	0.09	BR101	0.30	BY203-12	0.60	ITT1075	0.25	1N4003	0.05
BA102	0.30	BY100	0.20	BY203-16	0.65	ITT2001	0.25	1N4004	0.06
BA111	0.98	BY103	0.35	BY203-20	1.00	ITT2002	0.20	1N4005	0.06
BA115	0.25	BY118	1.45	BY204-4	0.45	MR502	0.75	1N4006	0.07
BA145	0.15	BY126	0.15	BY204-8	0.65	MR813	0.90	1N4007	0.08
BA148	0.12	BY127	0.10	BY204-10	0.75	MR854	1.80	1N4148	0.04
BA154	0.10	BY130	0.15	BY206	0.30	MR856	2.10	1N4150	0.45
BA155	0.12	BY133	0.10	BY210-400	0.45	MR992A	1.55	1N4448	0.25
BA156	0.12	BY134	0.45	BY210-600	0.50	MV2203	1.60	1N5401	0.12
BA157	0.45	BY142	0.45	BY210-800	0.55	MV5460	0.65	1N5402	0.15
BA158	0.65	BY164	0.50	BYX10	0.35	OA47	0.07	1N5403	0.15
BA159	0.75	BY176	3.45	BYX55-350	0.45	OA70	0.07	1N5404	0.16
BA182	0.45	BY179	0.90	BYX55-600	0.55	OA71	0.35	1N5405	0.25
BA201	0.15	BY182	1.85	BYX71-350	0.90	OA81	0.12	1N5406	0.20
BA243	0.85	BY184	0.70	BYX71-600	1.15	OA85	0.12	1N5407	0.19
BAX13	0.06	BY187	1.30	BZX61 series	0.18	OA86	0.20	1N5408	0.20
BAX16	0.07	BY198	0.75	BZY88 series	0.08	OA90	0.07	1N5450A	6.75
BAX17	0.10	BY199	0.55	DK13	0.45	OA91	0.06	1N5761	0.60
BB105B	0.35	BY201-2	0.40	ITT44	0.10	OA95	0.06		

LINEAR INTEGRATED CIRCUITS

CA3020	1.75	SC9504P	2.00	TAA300	3.75	TBA400	2.25	TBA750Q	2.50
CA3046	0.80	SL414A	4.85	TAA310	3.15	TBA510	2.40	TBA800	0.90
CA3048	2.50	SL415A	6.30	TAA320	2.60	TBA510Q	2.50	TBA800Q	2.85
CA3065	1.58	SL901B	8.50	TAA350A	3.00	TBA520	2.50	TBA810A	3.40
CA3089E	7.88	SL917B	10.70	TAA435	3.40	TBA520Q	2.50	TBA810S	1.10
CA3090Q	4.50	SL1310	5.65	TAA550	0.50	TBA530	2.50	TBA820	0.80
ETT6016	4.95	SL1327	2.75	TAA550B	0.40	TBA530Q	2.50	TBA915	7.35
ETTR6016	4.95	SL3046	2.60	TAA570	2.85	TBA540	2.50	TBA920	3.00
MC1303L	1.50	SN76003N	2.50	TAA621	6.95	TBA540Q	2.25	TBA920Q	3.50
MC1304P	2.00	SN76003ND	2.15	TAA630	8.55	TBA550	3.50	TBA950-2	5.40
MC1305	5.15	SN76013N	1.50	TAA630S	5.10	TBA550Q	3.80	TBA950-2X	5.04
MC1307P	2.85	SN70613ND	2.15	TAA661A	1.70	TBA560	6.45	TBA990	4.95
MC1310P	1.00	SN76023N	1.50	TAA661B	1.80	TBA560C	4.50	TBA990Q	3.75
MC1327P	2.75	SN76023ND	2.15	TAA700	3.50	TBA560Q	7.35	TCA160	5.10
MC1327PQ	2.50	SN76033N	2.40	TAA840	4.50	TBA560CQ	3.00	TCA270	3.00
MC1330P	1.25	SN76110N	1.50	TAD100	1.35	TBA570	2.00	TCA270B	3.60
MC1339P	3.95	SN76131N	2.00	TBA120A	3.05	TBA570Q	2.00	TCA270Q	3.60
MC1349	3.35	SN76226N	3.15	TBA120AS	1.50	TBA641A12	6.20	TCA270S	2.25
MC1351P	1.25	SN76226ND	3.15	TBA120S	2.70	TBA641B11	5.65	TCA270SQ	3.40
MC1352P	1.45	SN76227N	2.50	TBA120SB	1.60	TBA673	5.00	TCA800	5.40
MC1358PQ	3.85	SN76532N	3.15	TBA120SQ	1.60	TBA700	3.95	TCA800Q	12.40
SAA570	4.20	SN76533N	2.70	TBA281	4.70	TBA700Q	2.25	TCA830	3.10
SAA700B	10.15	SN76544N	1.80	TBA350A	3.00	TBA720	5.10	TDA440	6.75
SAS560	2.75	SN76550N	1.80	TBA396	1.80	TBA720A	5.10	TDA1327	2.85
SAS570	2.75	SN76660N	0.80	TBA440	3.60	TBA720AQ	2.10	TDA1327B	2.85
SBA750B	6.75	SN76666N	1.60	TBA4406	3.95	TBA750	2.40	TDA1330	1.60
SC9503P	2.00			TBA480Q	2.50			741	0.25

BRIDGE RECTIFIERS

CURRENT	VOLTAGE	ORDER CODE	PRICE
1A	50V	B1/50	0.25
1A	100V	B1/100	0.26
1A	200V	B1/200	0.28
1A	400V	B1/400	0.30
1A	800V	B1/800	0.34
2A	50V	B2/50	0.40
2A	100V	B2/100	0.45
2A	200V	B2/200	0.55
2A	400V	B2/400	0.65
2A	800V	B2/800	0.70
3A	200V	B3/200	0.70
3A	600V	B3/600	0.80
4A	100V	B4/100	0.90
4A	400V	B4/400	0.95
6A	50V	B6/50	0.95
6A	200V	B6/200	1.10
6A	400V	B6/400	1.20
10A	400V	B10/400	2.50
25A	50V	B25/50	4.00
25A	200V	B25/200	4.20
25A	400V	B25/400	4.30

I. C. SOCKETS

NO. OF PINS	ORDER CODE	PRICE
8	D8	0.10
14	D14	0.11
16	D16	0.13
20	D20	0.30
22	D22	0.35
24	D24	0.40
28	D28	0.45
40	D40	0.60

PANEL METERS

Size 2" x 2" x 1⅜"; requires 1¾ cut-out.

F.S.D.	ORDER CODE	PRICE
1mA	M1	5.50
500mA	M500	5.50

THYRISTORS

CURRENT	VOLTAGE	CASE	ORDER CODE	PRICE
80mA	30V	TO18	SO8/30	0.22
80mA	60V	TO18	SO8/60	0.24
80mA	200V	TO18	SO8/200	0.25
1A	50V	TO220	S1/50	0.25
1A	100V	TO220	S1/100	0.26
1A	200V	TO220	S1/200	0.28
1A	400V	TO220	S1/400	0.35
3A	50V	TO220	S3/50	0.25
3A	100V	TO220	S3/100	0.26
3A	200V	TO220	S3/200	0.30
3A	400V	TO220	S3/400	0.40
4A	50V	TO220	S4/50	0.35
4A	100V	TO220	S4/100	0.40
4A	200V	TO220	S4/200	0.50
4A	400V	TO220	S4/400	0.55
5A	400V	TO220	S5/400	0.55
7A	50V	TO220	S7/50	0.45
7A	100V	TO220	S7/100	0.50
7A	200V	TO220	S7/200	0.55
7A	400V	TO220	S7/400	0.60
8A	400V	TO220	S8/400	0.70

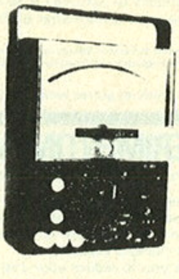
TRIACS

CURRENT	VOLTAGE	CASE	ORDER CODE	PRICE
3A	100V	TO220	T3/100	0.75
3A	200V	TO220	T3/200	0.80
3A	400V	TO220	T3/400	0.85
6A	200V	TO220	T6/200	1.00
6A	400V	TO220	T6/400	1.05
8A	400V	TO220	T8/400	1.35
10A	400V	TO220	T10/400	1.40
15A	400V	TO220	T15/400	2.00

ORDERING

Orders despatched by return of post. Payment with order, please add 20p for p/p with orders under £5, otherwise carriage free. No other charges – just send prices shown. Enquiries: please send s.a.e. Government departments and educational institutions just send official order. Mail order only.
Export orders welcome.

HIGH QUALITY MULTIMETERS

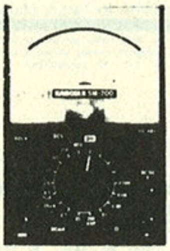


Q 1

£47.95 **100,000 opv**

Two in one instrument incorporating high sensitivity vom transistor checker

AC volts	0 to 5, 10, 50, 250, 1000
DC volts	0 to 0.5, 2.5, 10, 50, 250, 1000
DC current	0 to 10 ua, 0.025 ma, 0.5 ma, 5 ma, 50 ma, 500 ma, 10 amp
AC current	10 amp
Resistance	0 to 5K, 50K, 5 meg, 50 meg ohms
Decibels	10 db to +62 db
Transistors	usual measurements of NPN and PNP
Size	7 x 5½ x 2¾ inch



Q 2

£53.95 **200,000 opv**

Twenty six range professional instrument having accuracy of ± 3% of full scale

AC volts	0 to 5, 50, 250, 1000
DC volts	0 to 0.5, 2.5, 10, 50, 250, 1000
DC current	0.5 ua, 25 ua, 2.5 ma, 25 ma, 250 ma
Resistance	0 to 1K, 100K, 10 meg, 100 meg
Decibels	10 db to +62 db
Size	152 x 102 x 45mm

RESISTORS

¼W Values available in E12 series from 10R to 1M. **Price 0.03 each.**
½W Values available in E 12 series from 1R0 to 10M. **Price 0.03 each.**
1W Values available in E12 series from 2R2 to 10M. **Price 0.06 each.**
2W Values available in E12 series from 10R to 10M. **Price 0.11 each.**
5W Values available in E6 series from 1R0 to 6K8.
Prices 1R0 to 1K0 **0.19 each.**
1K5 to 3K3 **0.22 each.**
4K7 to 6K8 **0.24 each.**
7W Values available in E12 series from R47 to 22K.
Prices R47 to R82 **0.25 each.**
1R0 to 1K0 **0.26 each.**
1K2 to 12K **0.27 each.**
15K to 22K **0.28 each.**
11W Values available in E6 series from 1R0 to 22K.
Prices 1R0 to 1K0 **0.29 each.**
1K5 to 12K **0.30 each.**
15K to 22K **0.35 each.**
17W Values available in E6 series from 1R0 to 22K.
Prices 1R0 to 4K7 **0.39 each.**
6K8 to 22K **0.41 each.**

½W Single turn cermet potentiometer. Values available 100R, 200R, 500R, 1K0, 2K0, 5K0, 10K, 20K, 50K, 100K, 200K, 500K, 1M.
Price 0.97 each.

¾W Multiturn cermet potentiometer. Values available 20R, 50R, 100R, 200R, 500R, 1K0 2K0, 5K0, 10K, 20K, 100K, 500K.
Price 1.40 each.

1W Potentiometer with 2" spindle. Values available 10R, 25R, 50R, 100R, 250R, 500R, 1K0, 2K5, 5K0, 10K, 20K.
Prices 10R to 5K0 **1.51 each.**
10K & 20K **1.62 each.**

1.5W Convergence preset potentiometer. Values available 5R0, 7R0, 10R, 15R, 20R, 100R, 500R.
Price 0.50 each.

2W 10 Turn potentiometer. Values available 100R, 200R, 500R, 1K0, 2K0, 5K0, 10K, 20K, 50K, 100K.
Price 7.34 each.

CAPACITORS

Tantalum Bead		
6.3V	47uF	0.32 each
	100uF	0.50 each
16V	10uF	0.24 each
	22uF	0.30 each
	47uF	0.50 each
25V	22uF	0.41 each
35V	0.1uF	0.22 each
	0.22uF	0.22 each
	0.47uF	0.22 each
	1.0uF	0.22 each
	2.2uF	0.22 each
	4.7uF	0.24 each
Disc Ceramic		
8kV	150pF	0.27 each
	180pF	0.27 each
	200pF	0.27 each
	220pF	0.27 each
	250pF	0.40 each
	270pF	0.40 each
	300pF	0.40 each
Mixed Dielectric		
600V	1uF	1.01 each
1kV	0.01uF	0.26 each
	0.033uF	0.32 each
	0.047uF	0.35 each
	0.1uF	0.39 each
	0.22uF	0.58 each
	0.47uF	0.89 each
1.25kV	0.1uF	0.50 each
1.5kV	0.001uF	0.24 each
	0.0022uF	0.24 each
	0.0047uF	0.24 each
	0.22uF	0.28 each
Single Ended Electrolytic		
16V	10uF	0.11 each
	22uF	0.11 each
	47uF	0.11 each
	100uF	0.11 each
	220uF	0.14 each
	470uF	0.28 each
	1000uF	0.32 each
63V	1uF	0.11 each
	2.2uF	0.11 each
	4.7uF	0.11 each
	10uF	0.13 each
	22uF	0.16 each
	47uF	0.22 each
	100uF	0.32 each
	220uF	0.46 each
Double Ended Electrolytic		
10V	22uF	0.14 each
	100uF	0.14 each
	220uF	0.17 each
	470uF	0.36 each
	1000uF	0.40 each
25V	10uF	0.14 each
	22uF	0.14 each
	47uF	0.17 each
	100uF	0.17 each
	220uF	0.36 each
	470uF	0.47 each
	1000uF	0.72 each
63V	1uF	0.14 each
	2.2uF	0.14 each
	4.7uF	0.14 each
	10uF	0.17 each
	22uF	0.17 each
	47uF	0.29 each
	100uF	0.40 each
	220uF	0.65 each
	470uF	0.66 each
	1000uF	1.01 each
	2200uF	1.44 each
100V	10uF	0.20 each
	22uF	0.25 each
	47uF	0.36 each
	100uF	0.61 each
	220uF	0.68 each
450V	1uF	0.27 each
	4.7uF	0.45 each
	10uF	0.53 each
	22uF	1.07 each
	33uF	1.22 each
Silvered Mica		
500V	3.3pF	0.18 each
	5pF	0.18 each
	10pF	0.18 each
	39pF	0.18 each
	100pF	0.18 each
	150pF	0.18 each
	180pF	0.18 each
	220pF	0.18 each
	330pF	0.36 each
	470pF	0.36 each
	680pF	0.36 each
	820pF	0.36 each
	1000pF	0.42 each
	2200pF	0.50 each
	8200pF	1.58 each
	10000pF	1.62 each
Multi-sectional Electrolytic		
30V	2500/2500uF	1.94 each
70V	2500/2500uF	2.70 each
300V	150/150/100uF	2.81 each
350V	200/300uF	2.46 each
	200/200/100/32uF	3.89 each
	150/100/100/100/150uF	4.75 each
	400/400uF	4.75 each
	300/300/150/100/50uF	5.18 each

NORMAN INSKIP

90, Charles Street,
Greenhithe, Kent.
Tel: Greenhithe (0322) 844985